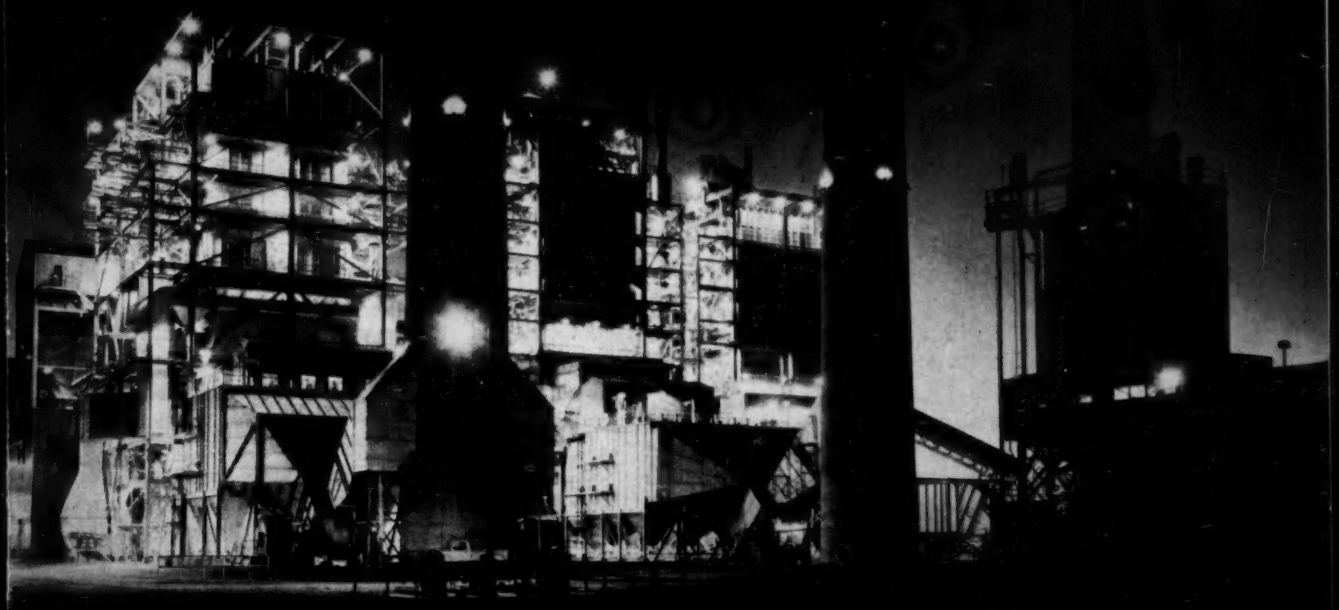
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

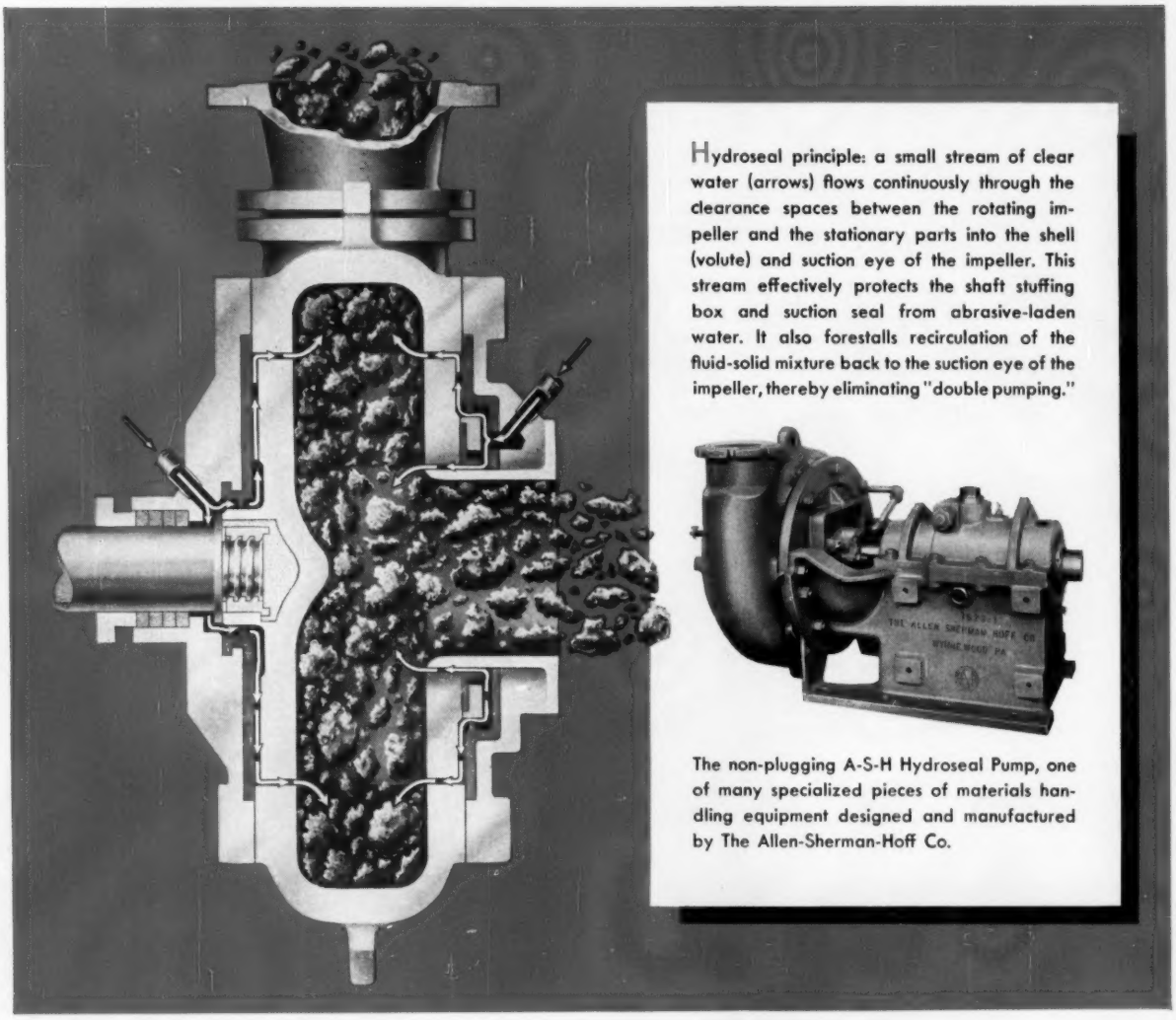
MAY 1956 • 50¢



Utah's Gadsby Plant burns petroleum pitch — 75

How Garlock modernized — 84

Insure sound pipe welds — 110



Hydroseal principle: a small stream of clear water (arrows) flows continuously through the clearance spaces between the rotating impeller and the stationary parts into the shell (volute) and suction eye of the impeller. This stream effectively protects the shaft stuffing box and suction seal from abrasive-laden water. It also forestalls recirculation of the fluid-solid mixture back to the suction eye of the impeller, thereby eliminating "double pumping."

The non-plugging A-S-H Hydroseal Pump, one of many specialized pieces of materials handling equipment designed and manufactured by The Allen-Sherman-Hoff Co.

A-S-H HYDROSEAL PUMPS... Best for handling abrasives

If you're plagued with abrasive materials handling problems, consider these advantages of the A-S-H Hydroseal Pump.

Maintains High Efficiency. A constant flow of clear water keeps abrasives out of the suction seal and stuffing box . . . protects them from damage. This Hydroseal water also eliminates "double pumping" by forestalling recirculation of fluid-solid mixture. Result: pump maintains initial efficiency, capacity and head for life of wearing parts.

Adaptability. Since there is no need to compensate for wear, any *fixed* pumping condition can be maintained without changing motor or pump speed. However, a simple change of V-belt drive ratio will adapt the same pump for a wide range of capacities and heads.

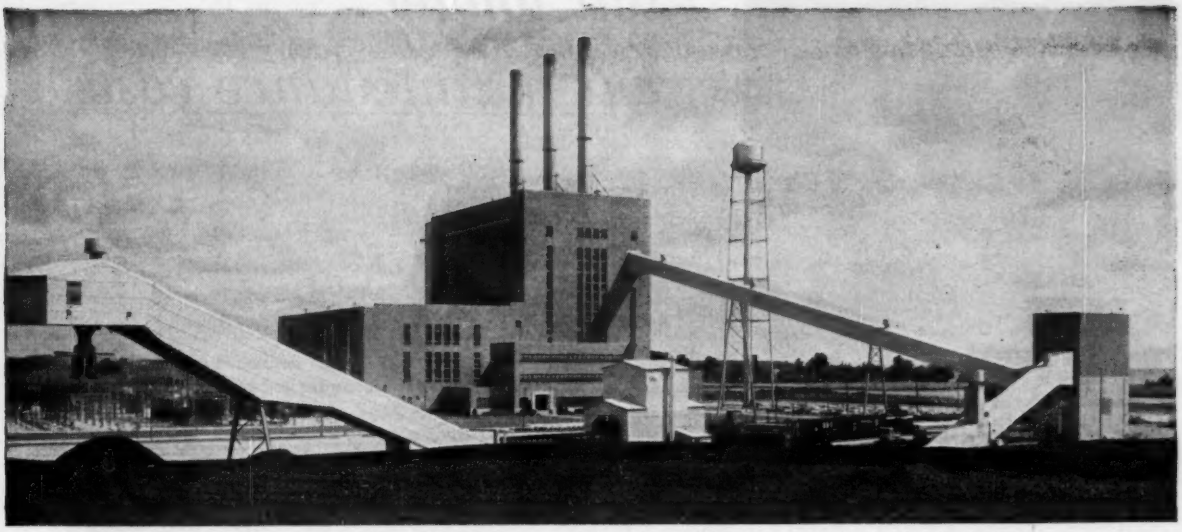
Rugged Construction . . . Low Maintenance. Wear-resistant chrome-nickel-iron alloy construction gives long life to shell and impeller. Replaceable rubber or metal liners protect engine and suction side bells. Simplicity of design affords easy dismantling and realignment of parts when servicing or repairing.

For complete technical information on the A-S-H Hydroseal Pump, write for your copy of Data Sheet Pa.

The **Allen-Sherman-Hoff** Company

259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

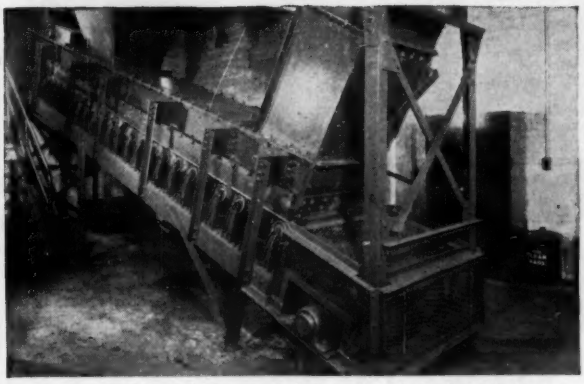
MATERIALS HANDLING SYSTEMS
hydroject *hydraulic* / **hydrovac** *pneumatic*



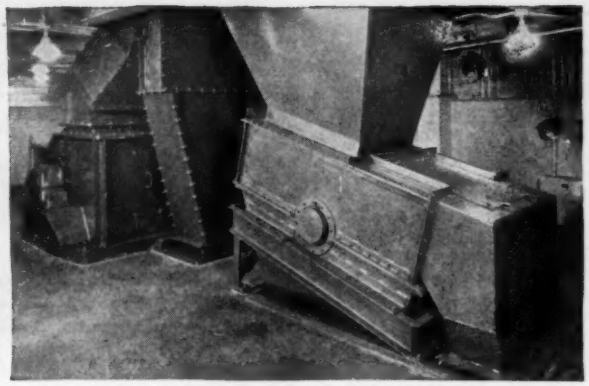
Justin R. Whiting Station uses 810,000 tons of coal per year, delivered to and from storage and to bunkers by Link-Belt conveyors.

An example of foresight . . . for power plants

building today–anticipating tomorrow



Impact troughing idlers protect belts at loading points. Enclosed transfers vented to dust-collecting systems for cleanliness.



Magnetic head pulley over crusher in background removes magnetic scrap, which is processed by Link-Belt vibrating screen.

Flexible LINK-BELT coal handling system is easily expanded . . . offers outstanding simplicity, cleanliness

CONSUMERS POWER CO.'s modern power plants are built to meet today's needs . . . with flexibility for adding facilities with minimum changeover as population growth dictates. In planning their 325,000-kw Justin R. Whiting Station, Erie, Mich., this utility realized that residential and industrial growth would require generating capacity to be doubled within ten years. And their coal handling system—furnished by Link-Belt—is ready to keep pace, with conveyors that can be speeded up and extended as proposed generating units are added.

Whatever your plant or boiler house requires in coal handling or power transmission equipment, Link-Belt will work with your own engineers and consultants in supplying it. From a complete line of equipment and unexcelled engineering background, you'll get a system that keeps your handling costs at a minimum.

Get complete facts from your nearest Link-Belt office. And be sure to ask for Book 2410 . . . illustrating examples of Link-Belt systems of all sizes.

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.921

DE LAVAL OPPELLER PUMPS

last longer... cut maintenance costs

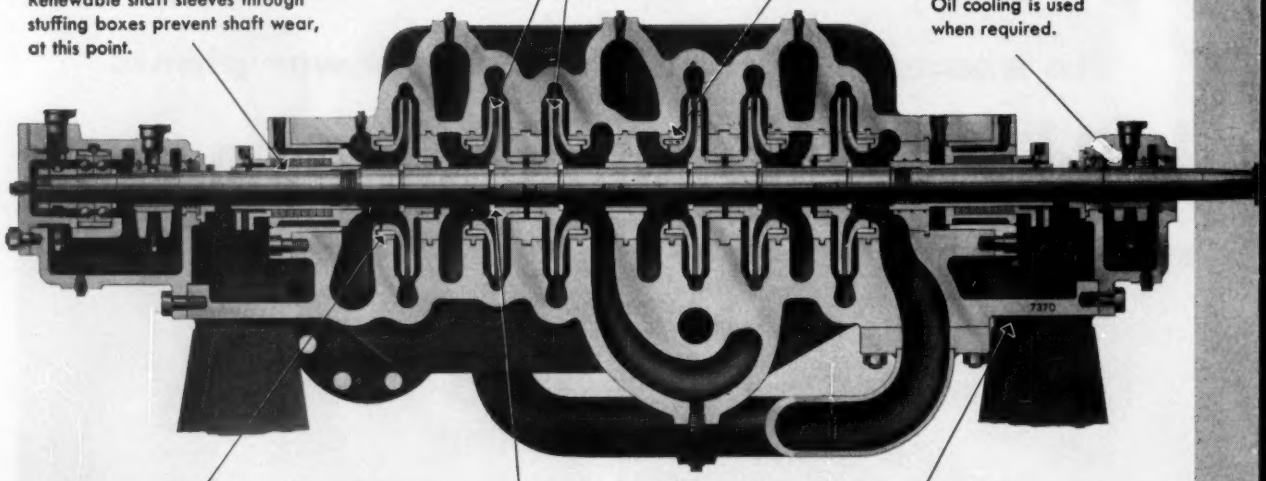
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

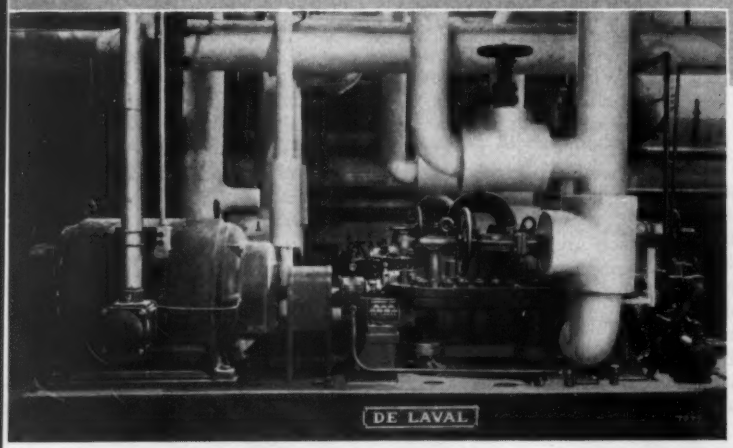
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 350F.

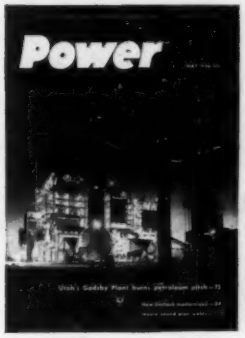
DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

Power

MAY 1956 • VOLUME 100 NUMBER 5



OUTDOOR PLANTS have a special glamor at night, as our cover picture shows. This shot was made at Gadsby Steam Electric Plant of Utah Power & Light Company.

Special interest attaches to this plant's multi-fuel setup, including use of petroleum pitch piped from a refinery 4½ miles to the north. Unit No. 1 burns pitch; No. 2 pitch, coal or gas, or any combination; No. 3 coal or gas, or a combination. Result is a net kwhr for 0.89 lb coal equivalent, at a fuel cost of 2.63 mills. For details, see story beginning on p 75.

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Next month . . .

Industrial lighting gets full treatment in a 24-p special report, ranging from fundamental principles to a look into the future. Between these end points you'll find meaty, practical dope on lamp types and characteristics, modern lighting fixtures, planning a topnotch lighting system, and maintenance.

It all adds up to what plant engineers and consultants need to know to meet today's higher illumination levels efficiently and at low cost.

Moving coal several hundred feet, with some tricky turns, posed a tough problem for Standard Forgings, Inc. Upcoming article tells how they licked it with a pneumatic system.

Teamwork is the secret of smooth operation. From sucessful experience, Exide's Ervin Seltzer lines up 15 ways to build top teamwork in your plant.

. . . and future months

Watch for the low-down on operating problems of nuclear power plants.

Print order this issue: 48,275

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FOR ALL TURBINES

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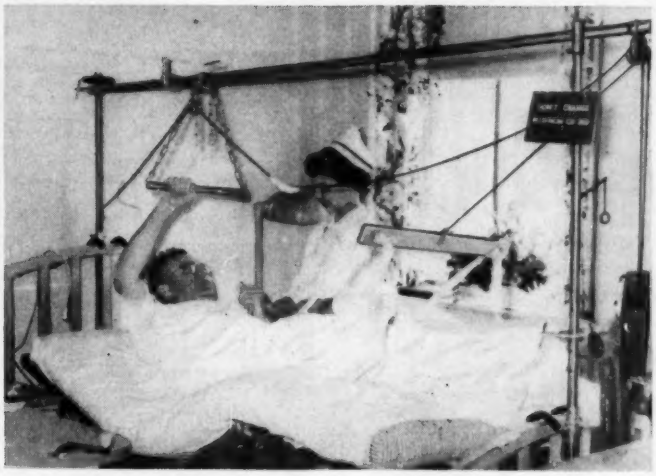
speaking of **Power**

That engineering mind – it works even on a hospital bed



O'Connor, nurse, and improved traction rig

Back to the office this week came our managing editor, Jim O'Connor. As a souvenir of a short sojourn in Hackensack Hospital he carried the photo at the left. As you'll see, it's also proof that an engineer can always find something that needs improvement — and come up with a simple and effective scheme for doing the job.

Jim's troubles began when he woke up one morning early in March with a back that stabbed with pain whenever he moved. With a slipped spinal disk as the diagnosis, he got no relief from the first step, strapping. So into the hospital went Jim—flat on his back with 35 lb of traction to relieve pressure on the disk. You see the rig in the photo, just to the right of the nurse. Weights applying the traction can just be seen at extreme lower right, suspended from a pulley on the frame. When Jim had to be moved, the weights had to be lifted by hand—not an easy job for the nurses. Always inventive, Jim quickly devised a scheme to allow him to do the lifting, save the busy nurses.

O'Connor's idea, like all good ones, was essentially simple He had two extra pulleys rigged on the frame, with a line fastened to the weights at one end and to the frame at the other. This line normally hung slack. When the weights had to be lifted, Jim had only to grasp the line above his head and pull—good exercise for Jim and easier going for the nurses.

Right now, Jim is sporting a plaster cast designed to keep the unruly disk properly positioned in the O'Connor spine. Before the hot weather comes along, he hopes to be able to shuck the cast and hit his usual energetic pace.

Wanted: Original material on George H Corliss

Old-time power men who started back in the heyday of the Corliss engine may be able to help in gathering information about the late George Henry Corliss. A biography of this distinguished Providence engineer will be written by Samuel J Berard, professor of engineering at Brown University. Prof. Berard writes:

"If any POWER readers have documents, letters, or knowledge of materials that would shed light on the life and work of Mr. Corliss, I would be grateful if they would communicate with me at Brown University Library, Providence 12, R. I.

"If such documents could be loaned to me, I shall have them copied and return the originals to their owners. If, on the other hand, the owners should desire to deposit the originals with the other Corliss papers already in the Brown University Library, they will be cataloged and made available to scholars."

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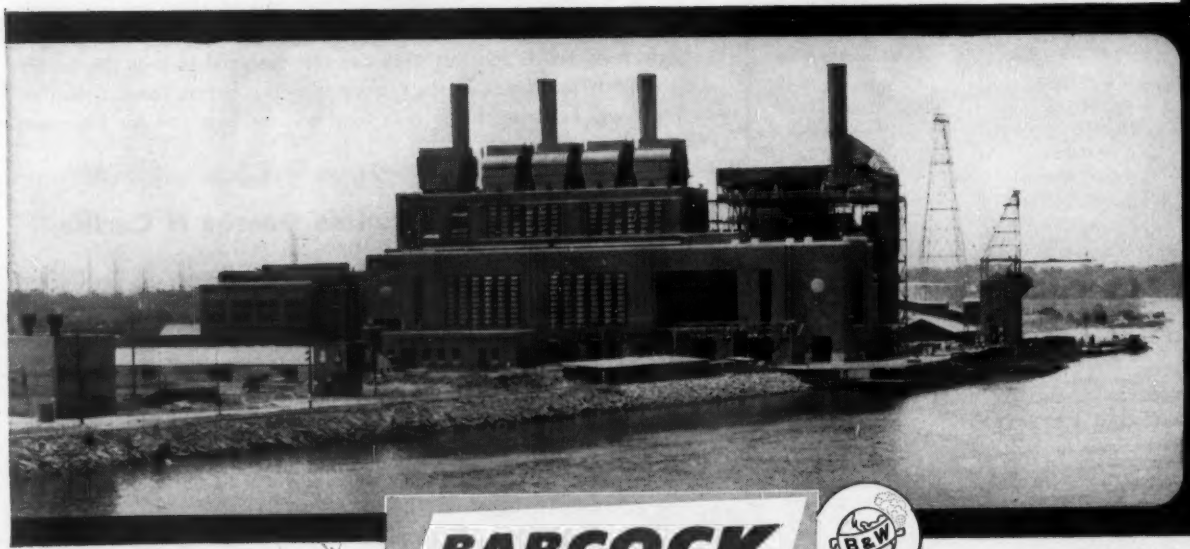
OF PUBLIC SERVICE ELECTRIC AND GAS COMPANY



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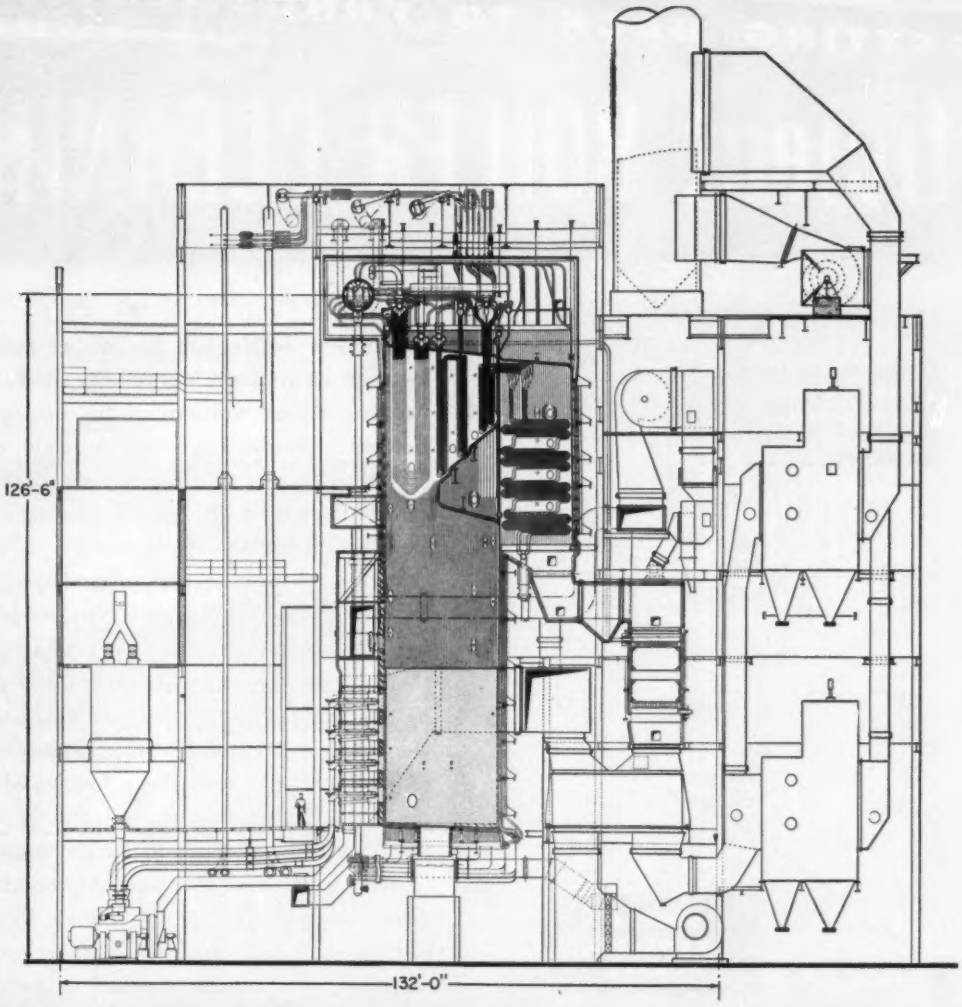

Supported by sound, practical engineering, Public Service Electric and Gas Company is engaged in a continuing, progressive policy of planning and over-all expansion to provide abundant, economical electricity to its large body of customers.

As part of this far-sighted program, Public Service Electric and Gas Company has installed a new, highly efficient 185,000 KW unit at its Burlington Generating Station. A B&W Radiant Boiler, generating over 1,225,000 pounds of steam per hour, contributes to the high level of performance of this new installation. The boiler is pulverized-coal-fired with provision for oil-firing, and is served by five B&W pulverizers. It is designed with divided furnace construction, gas recirculation, pressure firing and natural circulation. Unit design pressure is high—2700 psi, and the temperature is 1100 F at the superheater outlet with reheat to 1050 F.

Modern, efficient B&W steam generators, such as the latest unit at Burlington, are the results of long experience in designing, fabricating, erecting and servicing central station boilers of all types. Reinforcing this experience is an unending program of B&W research and development aimed intensively toward achieving still higher efficiency levels in the future.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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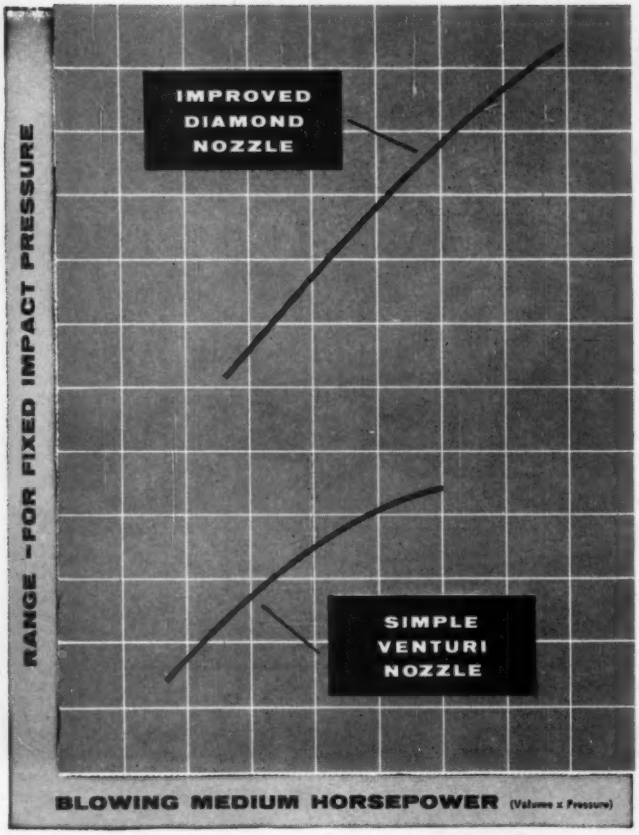
GETTING BACK TO FUNDAMENTALS:

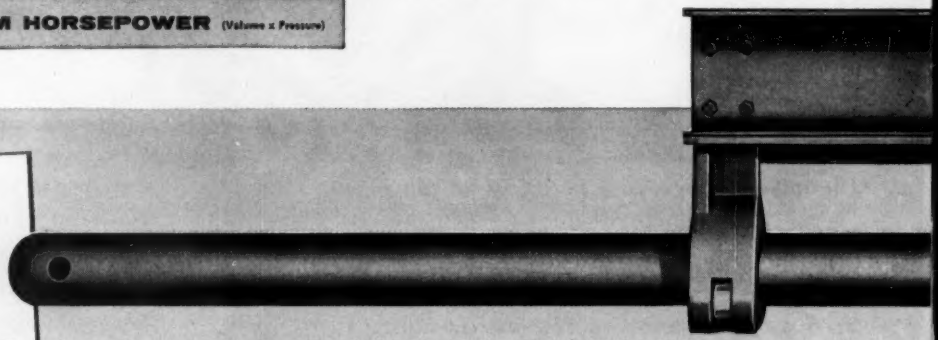
Efficient BOILER CLEANING


IMPROVED DIAMOND NOZZLE
SIMPLE VENTURI NOZZLE
RANGE – FOR FIXED IMPACT PRESSURE
BLOWING MEDIUM HORSEPOWER (Volume x Pressure)

The blower nozzle has the job of converting steam or air pressure into velocity which, in turn, produces impact pressure at the surface to be cleaned. Effective cleaning depends on this impact pressure. A well-designed nozzle will convert much more efficiently . . . doing a better cleaning job with less steam or air.

During the past several years Diamond has conducted intensive research into nozzle design to find the ultimate in efficiency. (More than 50 designs were tested.) It was soon found that nozzle design responds to perfection of detail. Among the details studied were: (1) divergence angle of nozzle, (2) inlet radius as a function of throat diameter, (3) length-diameter ratio of nozzle, (4) area ratio of lance to nozzle throat, and (5) nozzle approach conditions. A product of this research is our new "Type A" Nozzle for Model IK Blowers. The curves at the left show how much more efficient it is than the simple venturi nozzle. The result is improved cleaning at substantially lower energy cost.

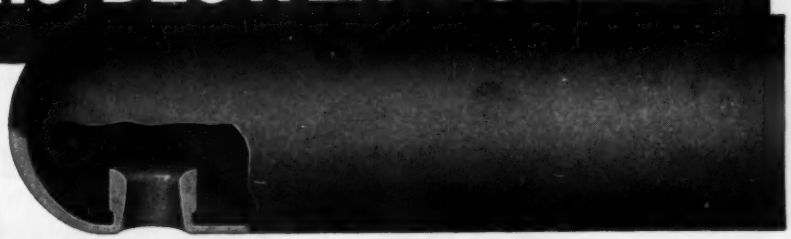
YOU CLEAN BOILERS *BETTER* and at *LOWER COST* with DIAMOND BLOWERS



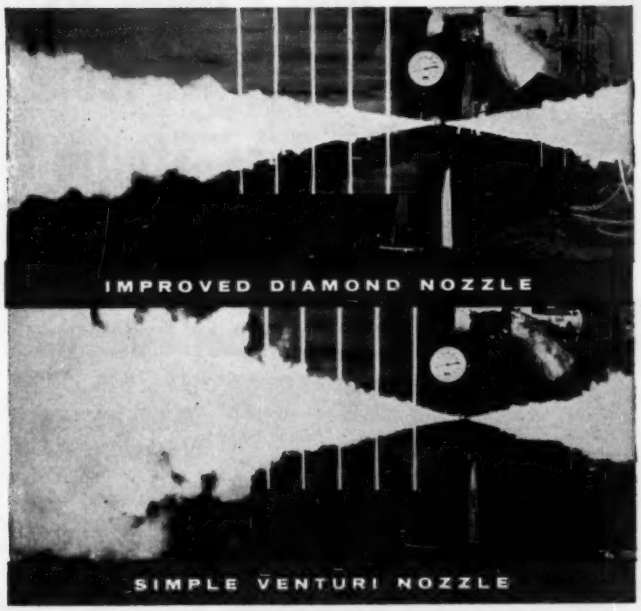
DIAMOND MODEL IK LONG RETRACTING BLOWER

A SINGLE motor (air or electric) both rotates and propels the long lance tube through a simple and rugged gear system. Only one set of motor elements, one set of control elements and one set of power supply facilities to operate and maintain. Flow control of blowing medium (steam or air) is automatic, positive and accurate by means of a simple, mechanically operated valve. This valve is poppet type and has adjustable pressure control. The improved nozzle design coupled with the close helical cleaning pattern assures maximum effectiveness for each blower operating cycle. For additional advantages, write for Bulletin 1080U.

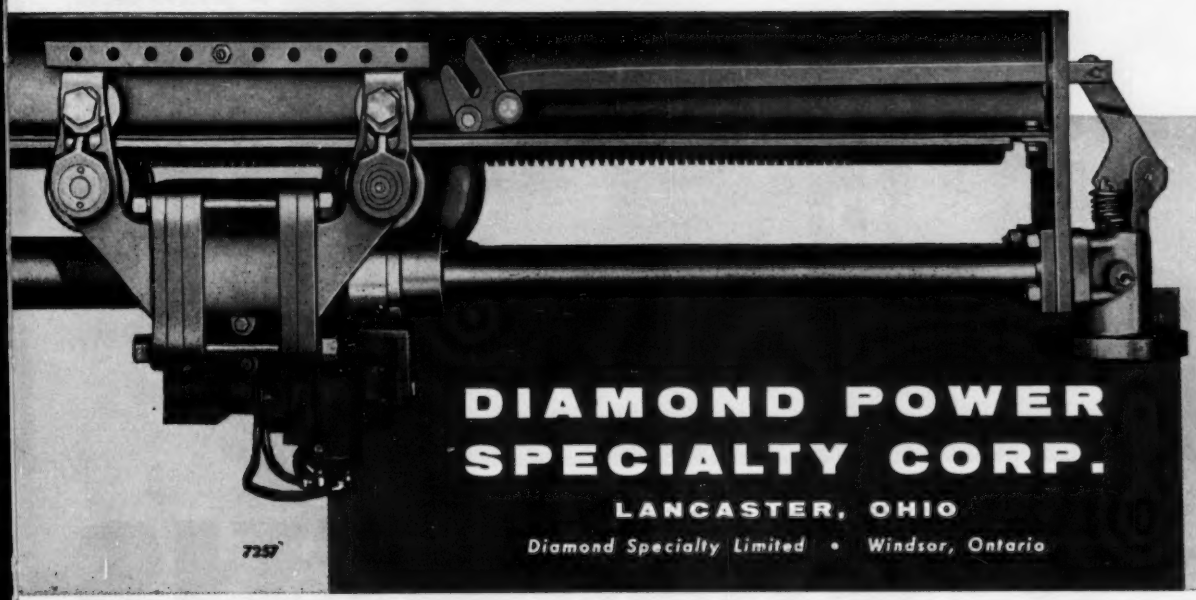
Starts at the BLOWER NOZZLE



Photograph of section through Diamond "Type A" Nozzle.



The two photographs at the left show the Improved Diamond Nozzle and the simple venturi nozzle under identical test conditions. These tests proved that the effective range of the new Diamond nozzle is substantially greater. Also that at the same range, the impact pressure of the Improved Diamond Nozzle is much higher than for the simple nozzle. For equal cleaning ability, the higher efficiency of the new Diamond nozzle requires a much lower blowing medium pressure.



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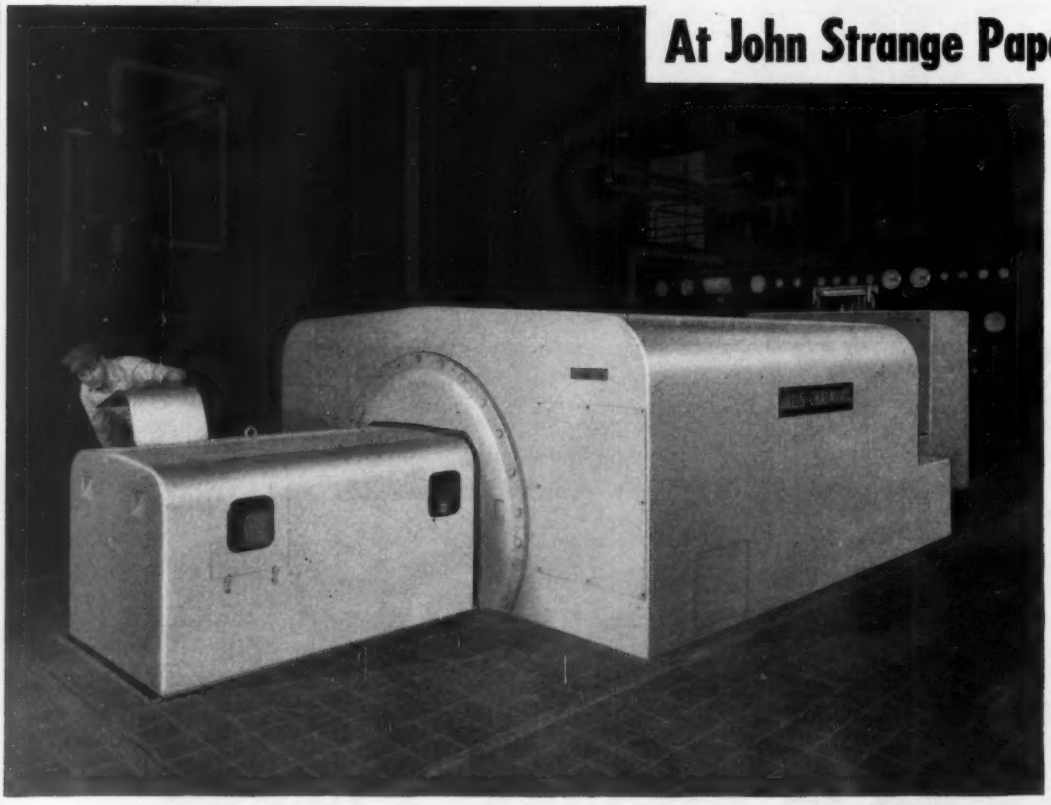
Paper Mills Choose for

WA-Series

STEAM TURBINE GENERATOR UNITS

Produce Economical Plant Power as By-Product from Process Steam



At John Strange Paper Company

MENASHA, WISCONSIN

5000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of 150,000 lb per hour of process steam. Steam conditions at the turbine are 700 psig, 825 F, with 50 psig exhaust.

ALLIS-

Allis-Chalmers Units Power Generation

The paper industry is a good example of many industries across the country that are choosing modern Allis-Chalmers WA-Series steam turbine generating units for plant power generation. Many installations are already operating in NEMA ratings from 2000 to 7500 kw. Recently, the line was extended to 16,500 kw in AIEE-ASME preferred ratings.

WA-Series units are available for condensing or non-condensing service, with or without automatic extraction, providing the kind of advanced design that power producers want. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets, and a time-proved governing system.

Engineered to Save Installation Costs

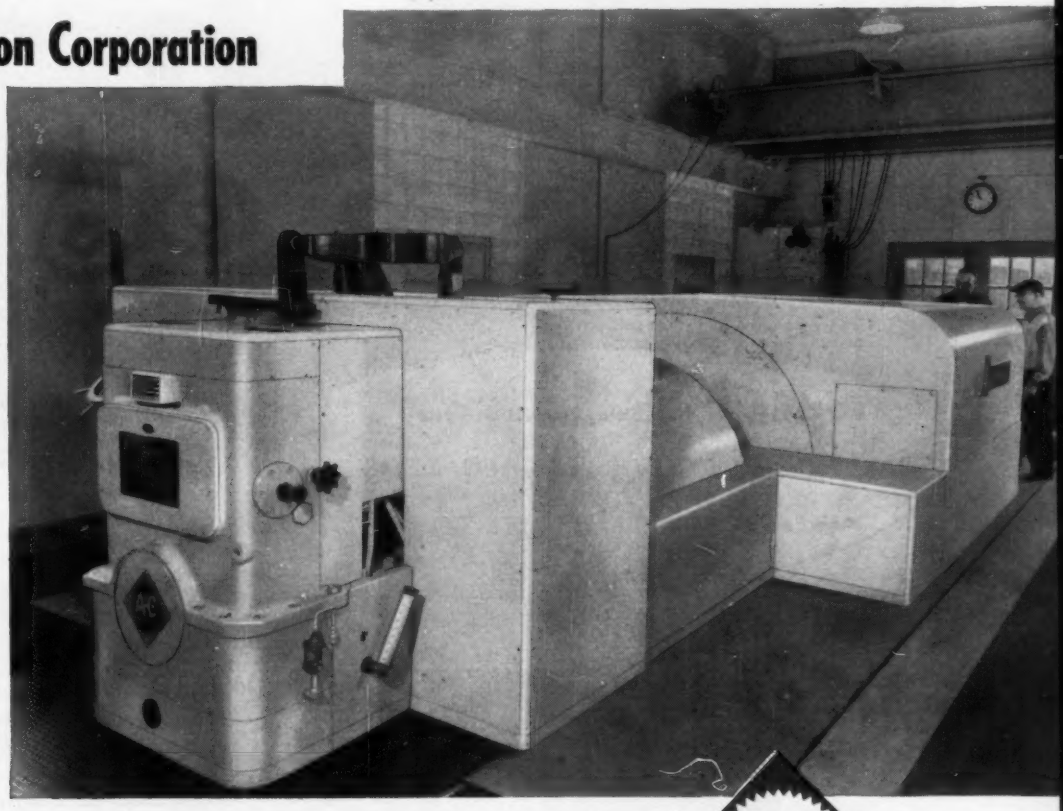
Particular care has been taken to promote ease of installation. Oil piping is above the floor line, eliminating need for trenches in the foundation. Generator gas coolers are located above the floor, eliminating ductwork through the foundation. Much of the work formerly done in the field is now performed in the factory. As a result, both turbine and generator can be shipped assembled ready for immediate installation.

For a detailed story on the advantages you can obtain with Allis-Chalmers steam turbine generating units, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 03B7654. A-4868

At Marathon Corporation

ROTHSCHILD, WISCONSIN

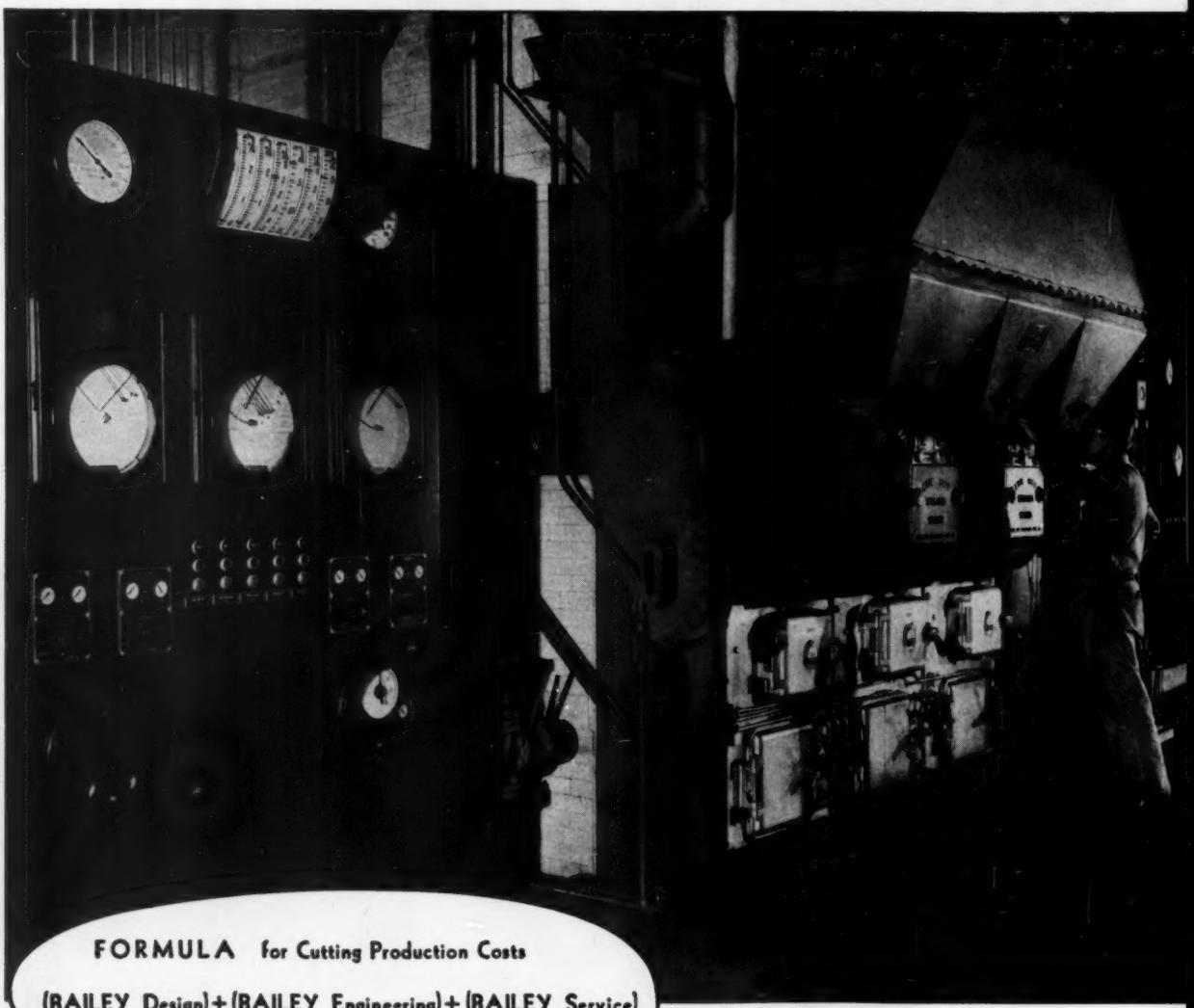
4000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of approximately 100,000 lb per hour of process steam. Steam conditions at turbine: 600 psig, 825 F, with 40 psig exhaust.



CHALMERS

A-C ALLIS-CHALMERS

How to Cut



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

At the heating plant of Lincoln Electric Co., Euclid, Ohio Bailey Control helps to cut operating costs by:

1. Controlling the rate of combustion in two spreader stoker-fired hot water boilers to maintain the desired temperature of outlet water.

2. Controlling fuel-air ratio at each boiler by means of a unique Btu-Air Flow meter which maintains most economical use of fuel.

3. Controlling quantity of water by-passed around boilers, thus tempering water supplied for heating in accordance with changes in outside temperature.

Operating Cost

★ When your plant is operating at peak efficiency, unit production costs are low. But outages of any kind upset the balance. As efficiency drops, and/or outages occur, overhead costs impose an increasing burden—bring on dollar losses that can't be recovered.

That's why you can use Bailey Co-ordinated Control Systems to advantage. Here are three reasons why Bailey systems are the best you can buy:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

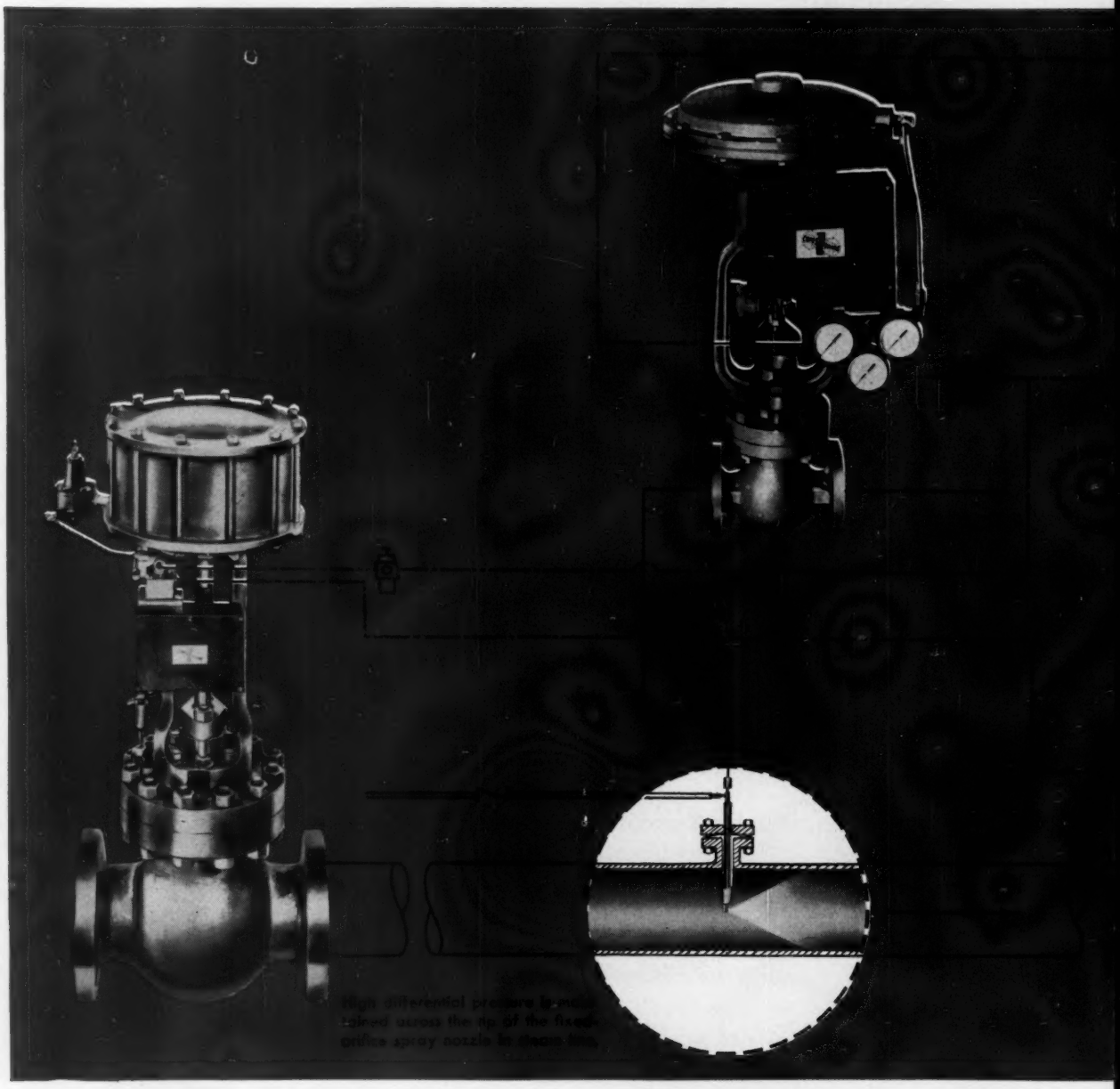
Bailey Meter Company's sales service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For lower operating cost—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-119A-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



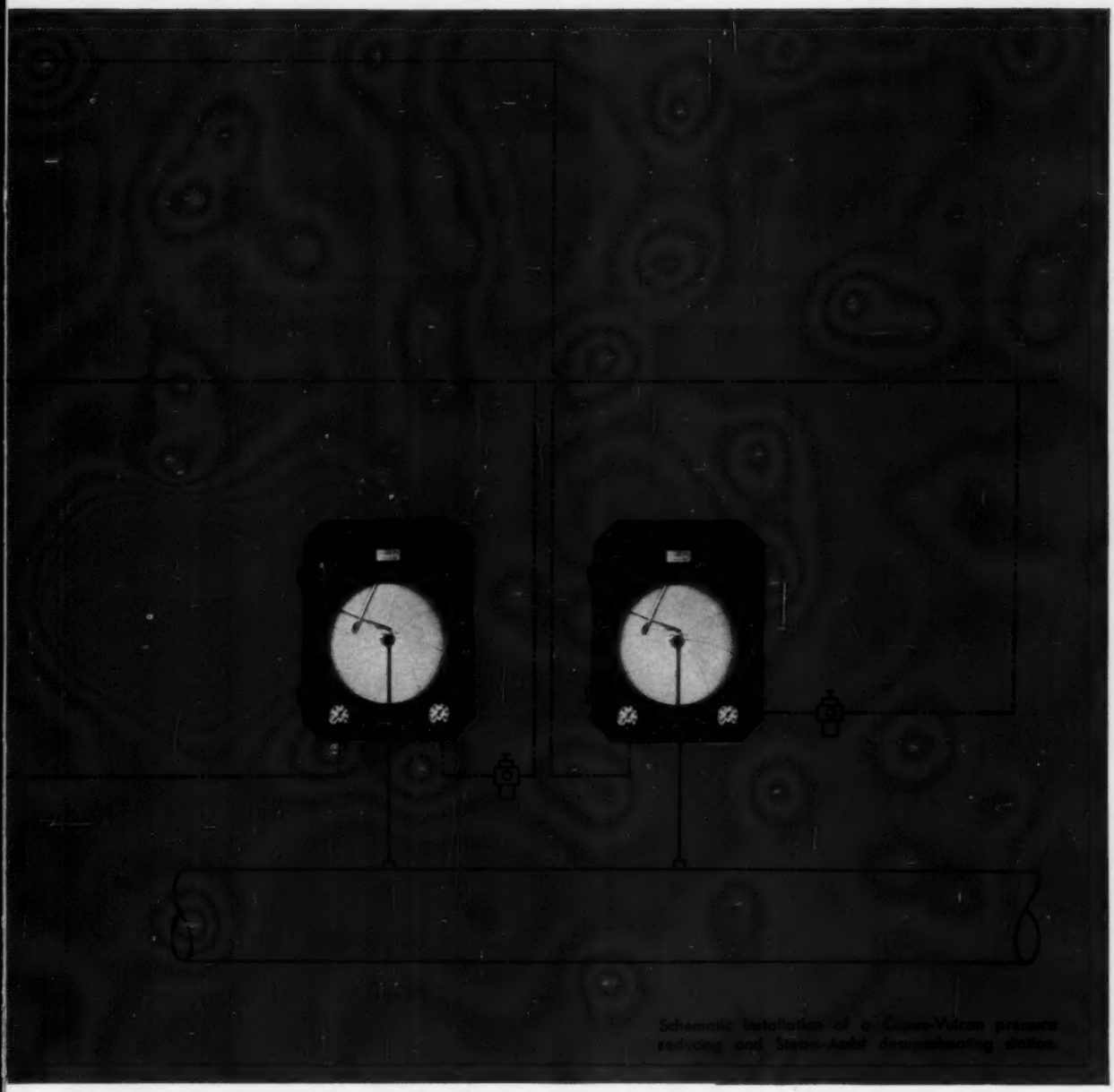
Copes-Vulcan offers in-line or carburetor type Steam-Assist, or simple mechanical-atomizing desuperheaters.

NEW Copes-Vulcan

These high-quality pressure reducing and desuperheating stations offer the latest advances in reducing valves and desuperheaters. They give you an integrated station designed specifically to meet your operating needs.

Copes-Vulcan valves—diaphragm or piston operated, depending on your conditions—give close modulating control. Simplified design means optimum operating characteristics with easy, low-cost maintenance.

The Steam-Assist Desuperheater advances a new principle in reducing steam temperatures. Cooling water and assisting steam are mixed in the exclusive



Schematic installation of a Copes-Vulcan pressure reducing and Steam-Assist desuperheating station.

Pressure Reducing and Desuperheating Stations

swirl chamber, upstream from the point of injection. No large steam bubbles form to cause hammer or vibration. Flow of assisting steam can be automatically reduced as load increases, and shut off completely at high loads where no more than mechanical atomization is needed.

"Packaged" control systems by Copes-Vulcan mean undivided responsibility, custom design and lifetime engineering service. They assure top performance over an unusually long service life.

COPES-VULCAN DIVISION

BLAW-KNOX COMPANY

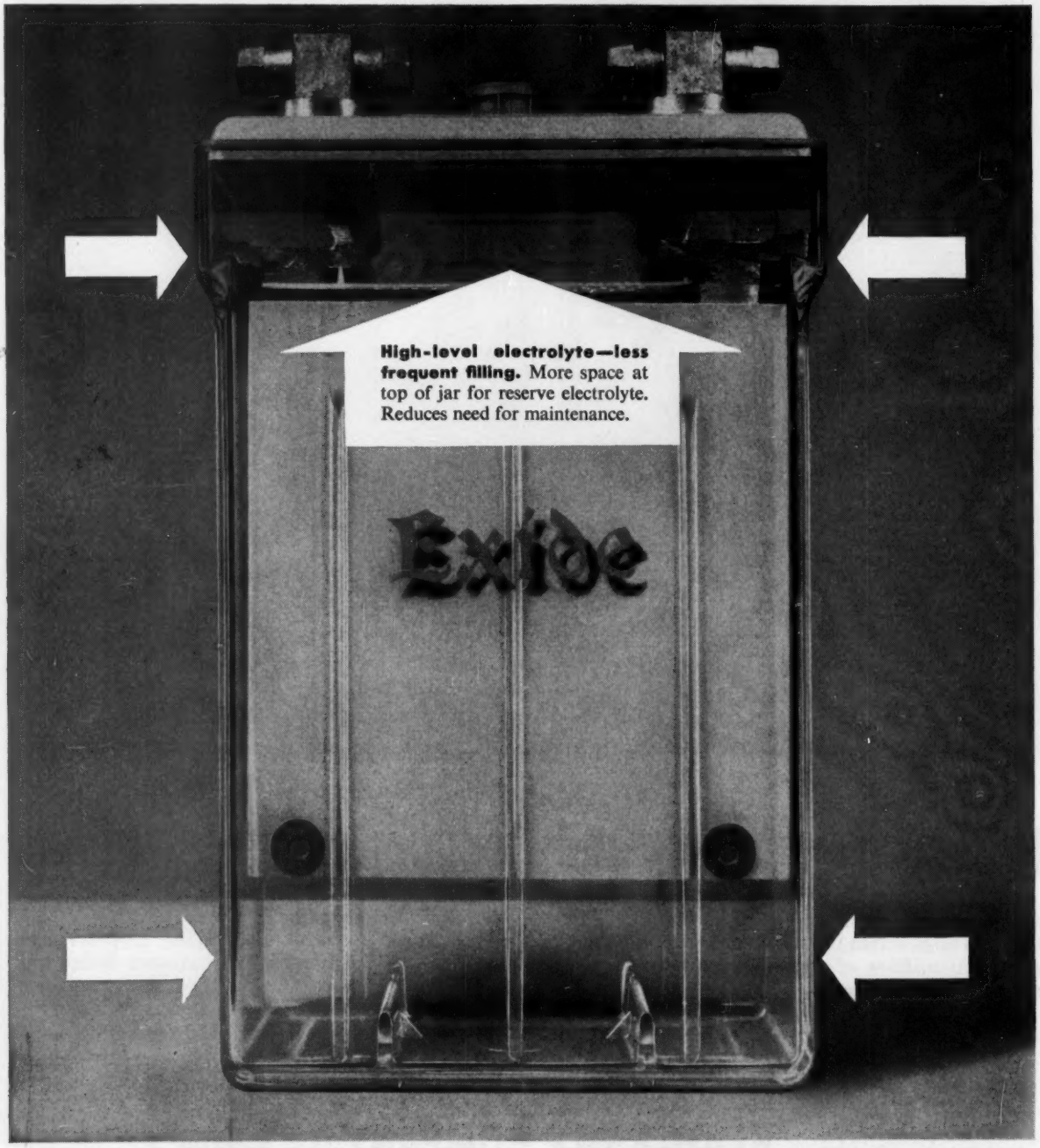
ERIE 4, PENNSYLVANIA

50th Anniversary BLAW-KNOX 1906-1956

THE NEW EXIDE-

Design advances increase capacity,

Suspended plates. See those ledges molded into the jar walls. That's where the plates rest—suspended from the top instead of being supported on the bottom. Both positive and negative plates hang free in the electrolyte.


High-level electrolyte—less frequent filling. More space at top of jar for reserve electrolyte. Reduces need for maintenance.
Exide

Look at this huge electrolyte reservoir at the bottom of the jar. Even in the heaviest cycling service, sediment can never short the plates. Extra electrolyte maintains high specific gravity even when the charge is 'way down. This feature is especially advantageous in countless applications where batteries are exposed to low temperatures.

MANCHEX BATTERY

life potential, and range of uses

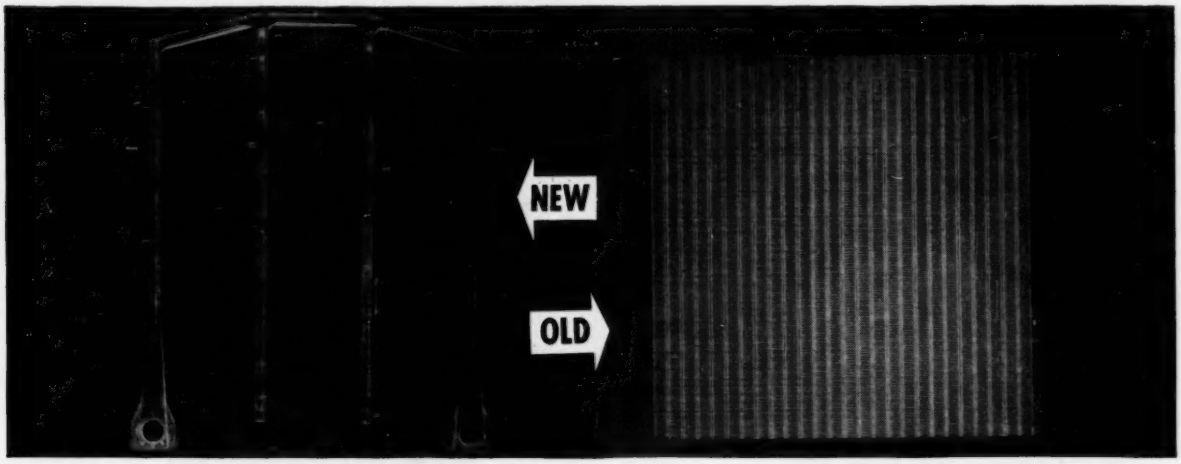
Trust Exide to make the world's most famous long-life battery even better.

In developing this completely new Exide-Manchex Battery, Exide engineers tackled the toughest battery problems that were yet to be solved. As a result, they not only improved the performance capabilities of the Manchex in floating service, but also qualified it for cycling service applications.

Here in one giant step forward, the Exide-Manchex Battery has moved years more ahead of every other battery in its field. Now it offers you even more value for your money, and even greater assurance of dependable performance all the years you use it.

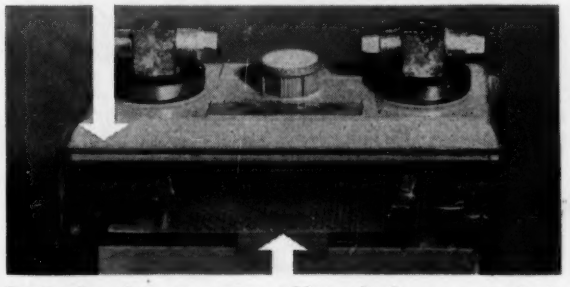
Be among the first to get complete information on this new Exide-Manchex Battery. Call your regional Exide representative. Or write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

Exide®

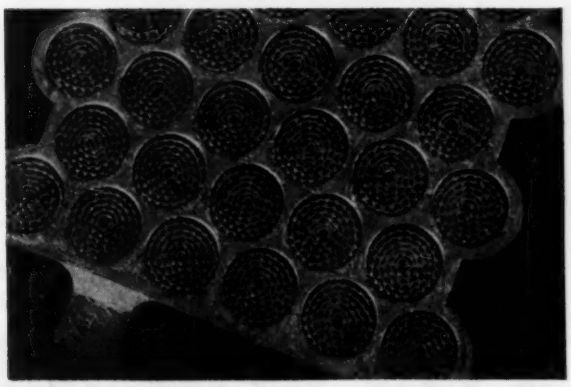


New open separator helps boost capacity. Sudden demands for battery power set positive plates to drinking up electrolyte in huge gulps—hard to do through dense separators. But this new open separator, combined with the high porosity microporous separator, gives every positive plate more elbow room. Electrolyte is free to flow to the plates more readily, more rapidly. Internal resistance of the battery is reduced. Battery capacity increased.

Improved plastic cover sealer. Special new sealer never dries out or cracks open. Welds cover to jar. Forms airtight, liquid-tight seal against leakage. Easily removed if necessary. Sealed-ring construction around posts prevents acid leakage.



Protection for separators. New plastic screen protects separators from damage during maintenance and testing; protects against foreign materials dropped into cell.



Exclusive Exide-Manchex positive plate. Pure lead spiral buttons are held tightly in sturdy grid. Act like shelves for oxide. Huge reserve lead-supply in buttons maintains capacity and stretches battery life.

NEW SUPERCHARGED

developed by Foster Wheeler

offers FIVE IMPORTANT

FOSTER WHEELER has developed a new supercharged boiler of far-reaching significance to the power industry.

In the supercharged cycle, diagrammed schematically on the facing page, high pressure combustion gases leaving the boiler are used to drive a gas turbine which, in turn, compresses combustion air for the boiler and drives an auxiliary generator. Spent gases from the turbine pass through an economizer and thence to the stack.

The following advantages are inherent in this supercharged boiler cycle.

1. There is a marked increase in overall plant economy. When utilizing maximum gas turbine operating temperatures, net power developed by the gas turbine can run as high as 15% of total plant output, with an overall gain of 10% in cycle economy. Even when operating at lower exit-gas temperatures, where the gas turbine is used only to drive the compressor, cycle economy is increased by the amount of power that would otherwise be required for operating the fans of a conventional boiler.

2. The supercharged boiler permits a rather astounding reduction in size and weight, due to much higher heat absorption rates. A supercharged boiler may weigh from ½ to ¼ as much as a conventional boiler of equivalent capacity. This, of course, permits a substantial saving in first cost—as much as 25% or more, depending on cycle conditions.

3. Start-up time is extremely short compared to that of a conventional steam generator.

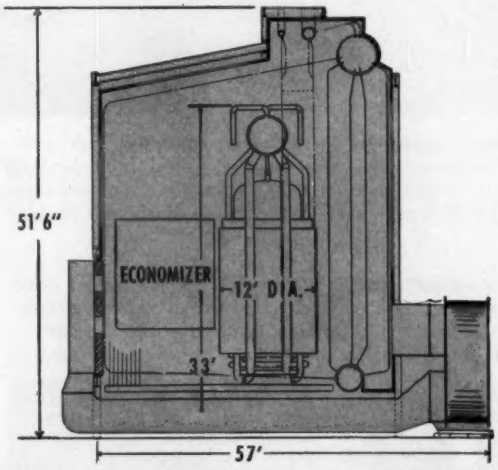
4. The supercharged boiler responds much more quickly to load changes.

5. Boilers can be completely shop fabricated and shipped ready to install.

To obtain the design symmetry essential for this pressurized firing service, the boiler drum is mounted separately above the boiler furnace—connected to it by external risers and downcomers. The furnace is fully enclosed with waterwall surface and a metal baffle separates the furnace tubes from the convection section. Superheated pancake coils are located in the base of the firing chamber.

Foster Wheeler has built three of these supercharged boilers and a fourth is now under construction. At present, units can be furnished for natural gas or light fuel firing.

For complete information on this important Foster Wheeler development, send for a copy of the December issue of "Heat Engineering". *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*



Comparison of physical dimensions of a conventional boiler (gray) and supercharged boiler (red). Both units are designed to furnish steam at 1200 psi, 950F for a 43,000 kw station.

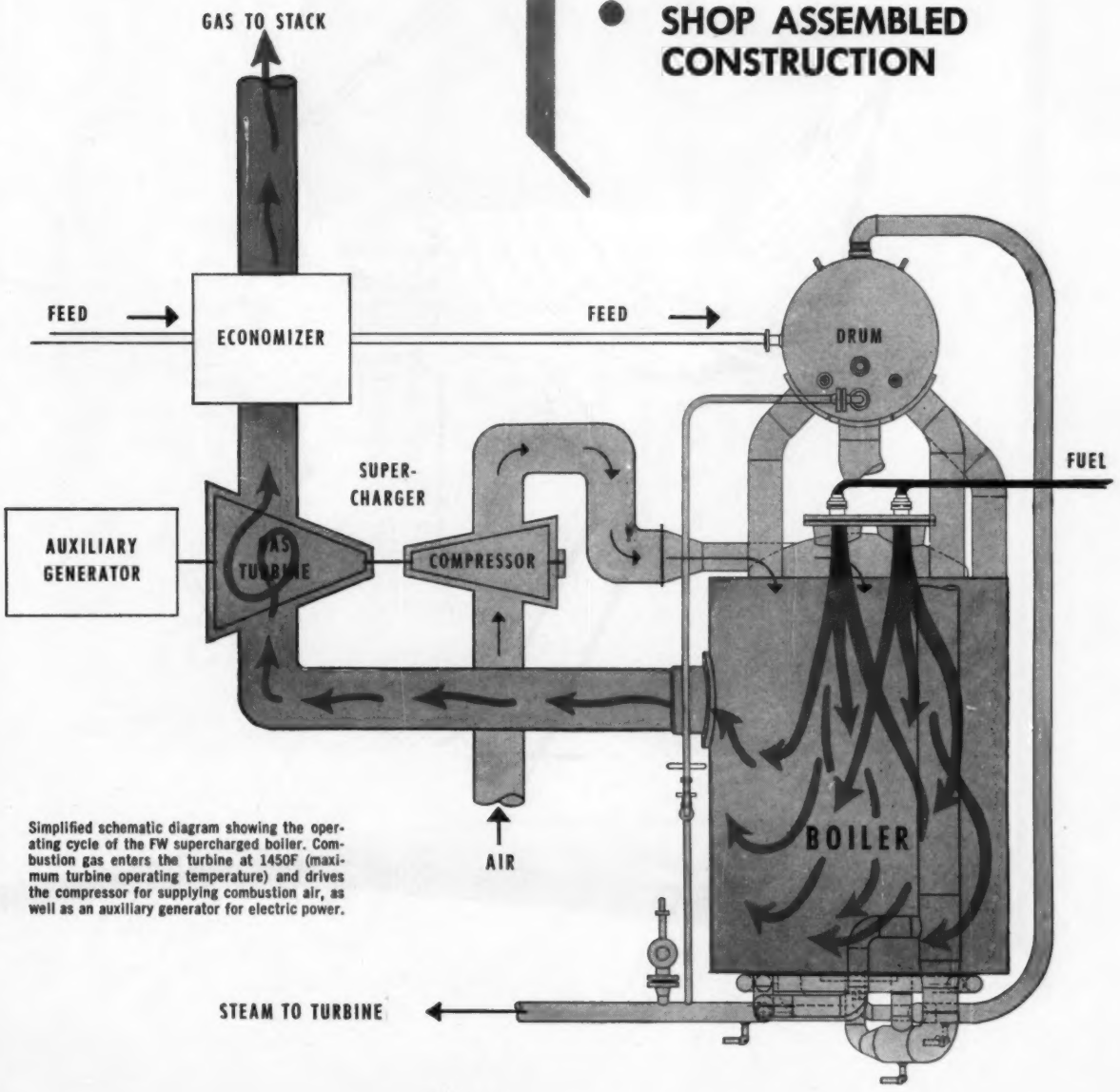
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

BOILER

ADVANTAGES...

- HIGH OVERALL ECONOMY
- DRASTIC REDUCTION IN SIZE AND WEIGHT
- SHORT STARTING TIME
- QUICK LOAD RESPONSE
- SHOP ASSEMBLED CONSTRUCTION

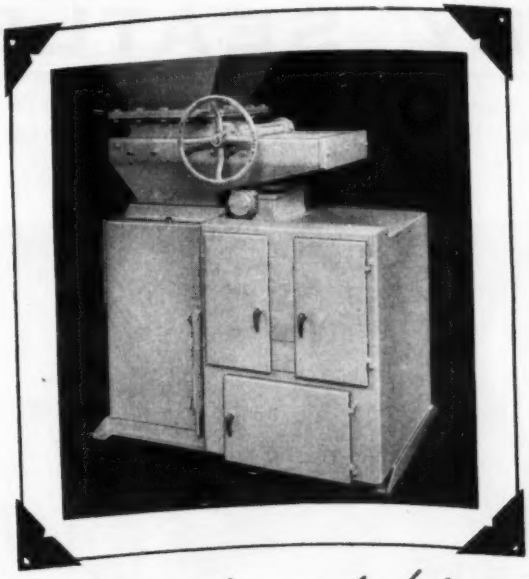


Simplified schematic diagram showing the operating cycle of the FW supercharged boiler. Combustion gas enters the turbine at 1450F (maximum turbine operating temperature) and drives the compressor for supplying combustion air, as well as an auxiliary generator for electric power.

It's BRAND SPANKING NEW!

BABY'S NAME Model 50 S-E-Co Coal Scale

BABY'S PHOTO



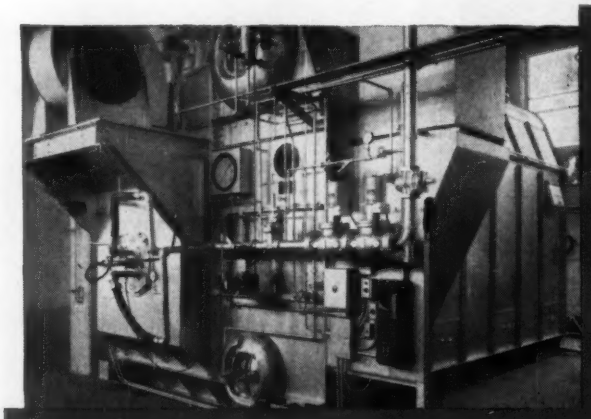
BABY'S WEIGHT Accurate and dependable

DISTINGUISHING FEATURES 24" square inlet opening - vertical skirts - no baffles - unrestricted 24" flow of coal throughout. Endless feeder belt carried on idlers - capable of moving full column of coal.

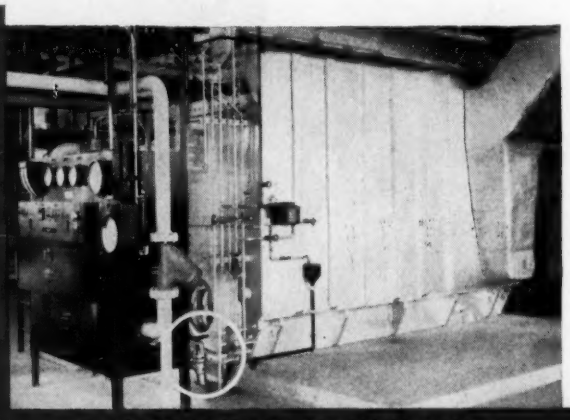
PROUD PARENTS The Stock Equipment Company
745 Hanna Bldg. Cleveland 15, Ohio

the blow-off valve trend on "package" boilers is

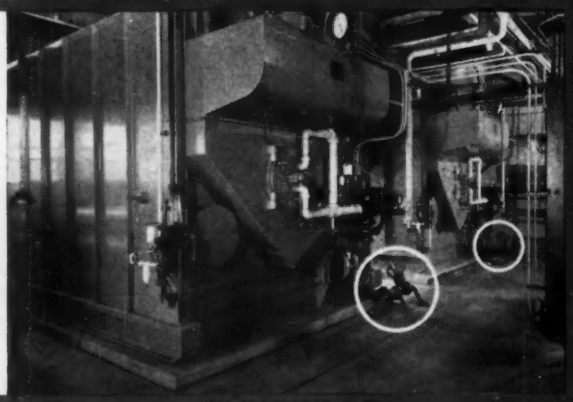
YARWAY SEATLESS



E. KEELER



COMBUSTION ENGINEERING



TITUSVILLE

KEWANEE-SPRINGFIELD

YARWAY® **BLOW-OFF**

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

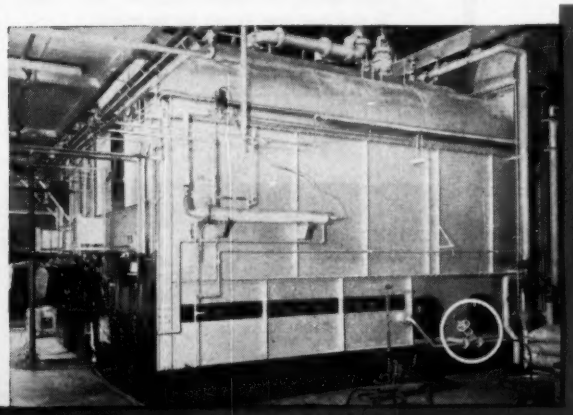
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

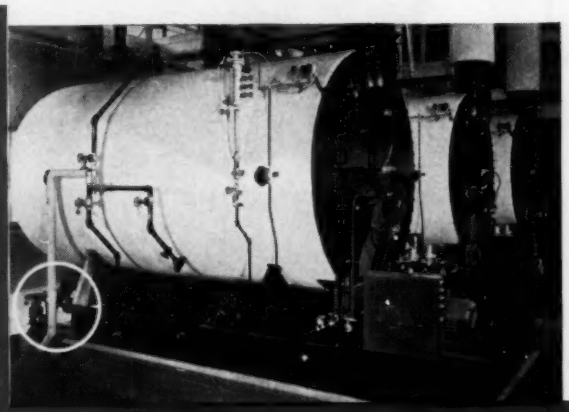
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

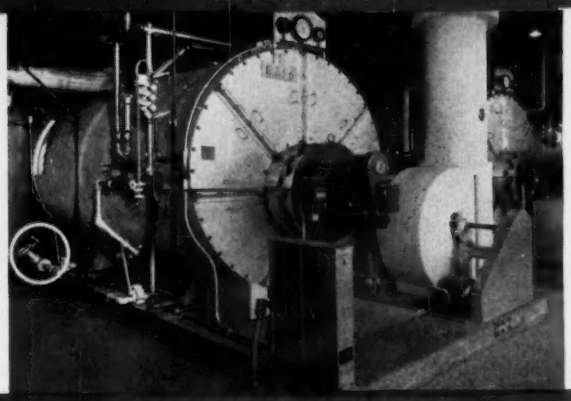
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



ERIE CITY



CLEAVER-BROOKS



PREFERRED UTILITIES

● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

VALVES

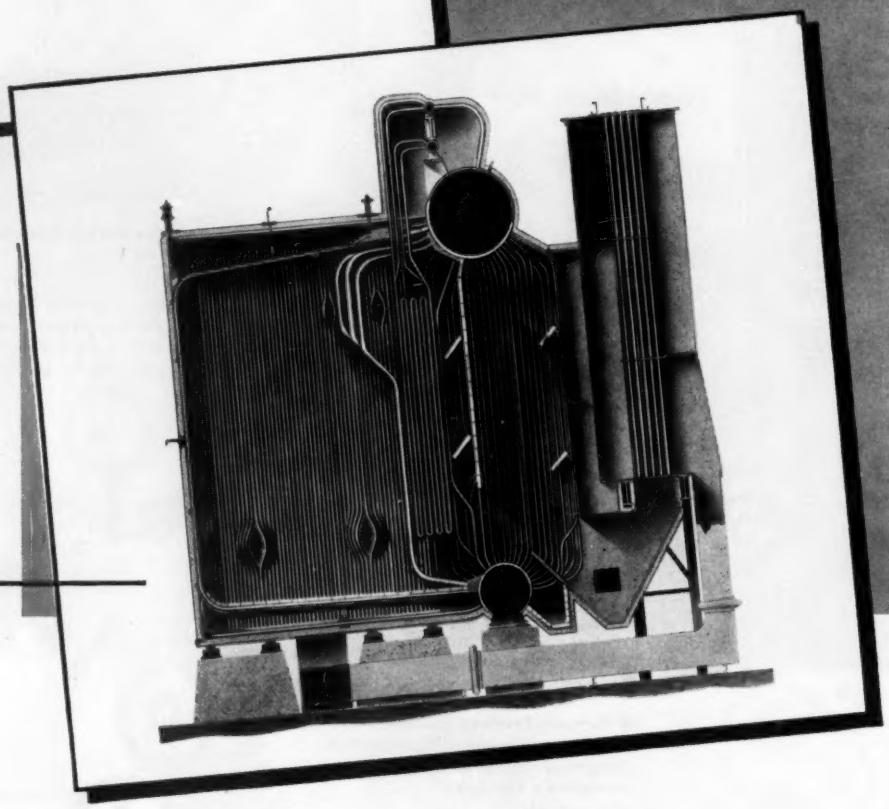
MODERN OIL AND

C-E Package Boiler—Type VP

Completely shop assembled . . . available in fourteen sizes from 4,000 to 40,000 lb capacity . . . pressures to 500 psi. Available with integral console control panel, this unit contains more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. It can be equipped with any of several approved burners.

C-E Vertical Unit Boiler —Type VU-55

Available in six sizes . . . capacities from 50,000 to 120,000 lb steam per hour . . . designed for two pressure ranges, 250 psi and 500 psi, and total steam temperatures up to 750 F. This double cased, gas-tight unit is equipped with tangential burners. A large (60-inch) steam drum assures generous water capacity and steam reservoir space. Tangent tube waterwalls offer complete furnace protection, minimizing maintenance.



COMBUSTION

Combustion Engineering Building

STEAM GENERATING UNITS • NUCLEAR REACTORS • PAPER MILL EQUIPMENT • PULVERIZERS • FLASH DRYING

GAS FIRED BOILERS

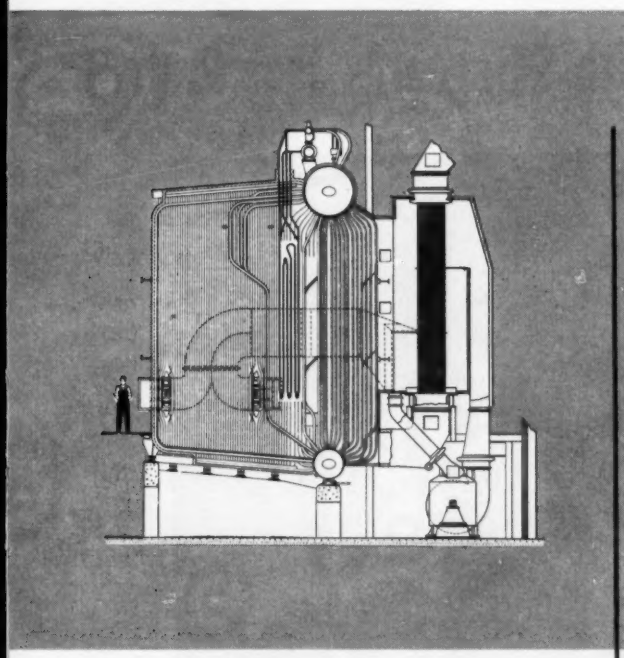
The boilers illustrated here cover the broad capacity range from 4,000 to 600,000 lb of steam per hr. They are all especially designed for gas and/or oil firing. The two units shown on the left page (Types VP and VU-55) are standardized and each is available in several sizes. The capacity range covered by these two units is from 4,000 to 120,000 lb per hr. The two units below are custom designed for various capacity, pressure and temperature requirements up to 600,000 lb per hr, 1400 psi and 950 F. All these units are pressure fired and do not require induced draft fans.

Collectively, they offer an exceptional diversity of choice. A brief consideration of the features of each type will help you "pinpoint" the design characteristics best suited to your particular needs.

Of course there are other C-E two drum Vertical-Unit Boilers available for pressures up to 1400 psi and temperatures up to 960 F. Shown here are but four popular members of the C-E family of Vertical-Unit Boilers—a family which has achieved a wide measure of acceptance using all types of fuel.

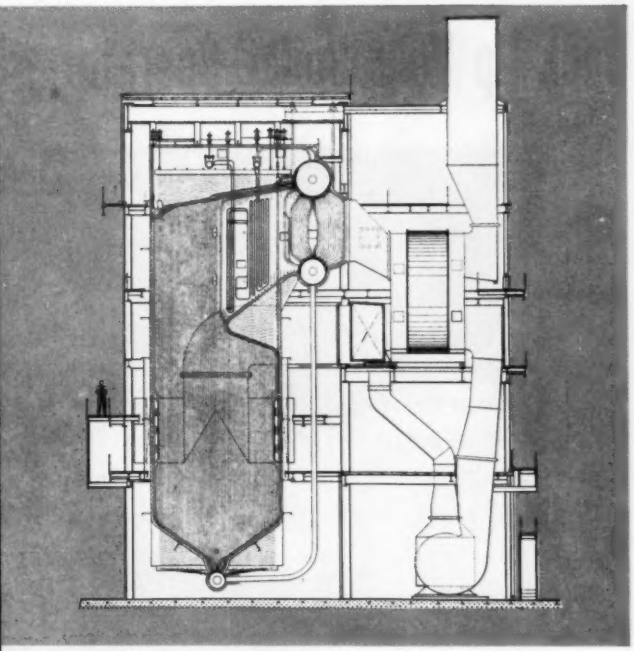
Please feel free to call on us for further detailed information. Catalogs are available upon request.

B-922



C-E Vertical Unit Boiler—Type VU-50B

This unit is available for capacities from 50,000 to 400,000 lb per hr—pressures to 1400 psi and temperatures to 950 F. This bottom-supported design uses tilting tangential burners providing effective superheat control. Horizontal burners can be furnished if desired. Heat recovery equipment as required. This unit makes available to industrial installations a standard of performance comparable to utility practice.



C-E Vertical Unit Boiler—Type V2

This unit is available for capacities from 200,000 to 600,000 lb per hr. It can be designed for pressures up to 1400 psi and for temperatures to 950 F. Tilting tangential burners, providing superheat control, are standard equipment although horizontal burners are available, if desired. A double, gas-tight casing assures lifetime tightness and minimum heat loss. Heat recovery equipment can be furnished as desired.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

SYSTEMS • PRESSURE VESSELS • HOME HEATING AND COOLING UNITS • DOMESTIC WATER HEATERS • SOIL PIPE

a fireye Interlock System

COULD HAVE PREVENTED THIS...

Back Up Your Boiler Operator with Safeguards that Protect

HOW FIREYE covers every step in the firing cycle —

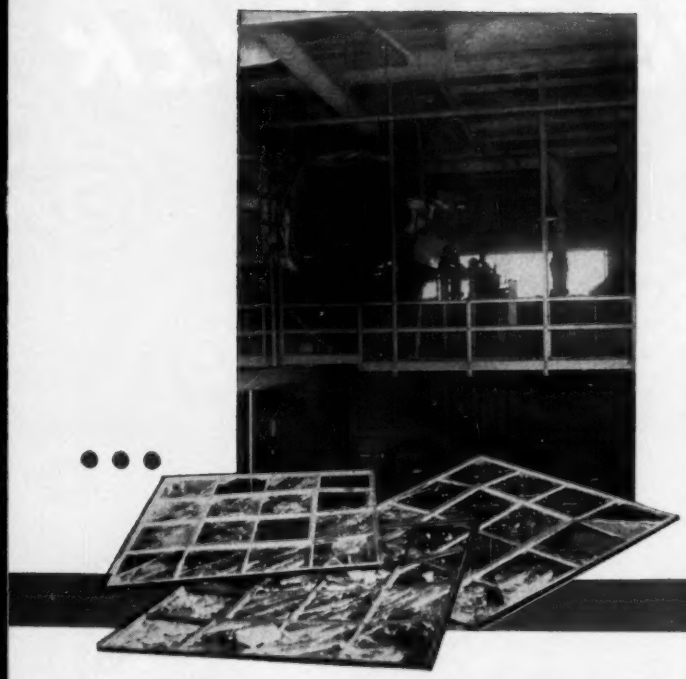
PREVENTS hurrying or skipping steps essential to safe operation

PREVENTS light-off until combustion chamber and passages are purged clean

BLOCKS main fuel supply until pilot is proved at the right point for light-off

SHUTS OFF fuel if main flame does not stabilize within the trial-for-ignition period

SHUTS OFF fuel and sounds alarm if the flame goes out during the firing period



NO SCHOOL TODAY

. . . and no boiler room either!

The boiler had been checked only five days before, by insurance company inspectors. They found it in perfect order, and praised this modern high school for excellent boiler maintenance.

But, one night while the furnace was shut down, an unsuspected gas leak filled the combustion chamber with an explosive mixture. There was no interlocked system for pre-purging the chamber and passages, and the purge step was skipped at light-off next morning. The resulting explosion sent the boiler engineer to the hospital, and caused damage estimated at $150,000.

A Fireye interlock system went in *after* the explosion . . . too late to forestall heavy loss, but a sure safeguard for the future.

Every Stage of Light-Off and Firing

Your boiler operator knows how great the need is for an assistant like Fireye. He knows that incorrect light-off or flame failure can occur in even the most modern burner installations. He knows that operators are only human, that they can slip. He is keenly aware that in an emergency no man can always act fast enough to avert disaster.

Fireye is the proved, complete, factory-integrated system that foresees and forestalls hazards of fuel burning in multiple-burner installations. With its Firetron "eye" that constantly monitors all stages of the firing cycle, Fireye acts within 2 to 4 *seconds* of the start of trouble. Its system of timers, interlocks, and shutoff valves automatically supervises every operating step.

The Fireye organization brings to your problems a knowledge and experience in fuel burning control that is without equal. It benefits you whenever Fireye engineers, located throughout the country, come in to survey your situation . . . supervise installation of Fireye equipment . . . check out the installation, and train your operating personnel.

Fireye alone can serve you so completely. Your need for its services may be greater than you realize. Mail the coupon for your copy of a non-technical bulletin that explains why most fuel-burner explosions happen, and how Fireye prevents them.

E C A fireye

Other ECA Divisions: Photoswitch Division • Fireye Division • Marine Division • Business Machines Division • Photoconductor - Transistor Division • Military Division

Protect Your Boiler NOW—send for this

COMBUSTION CONTROL DIVISION • ELECTRONICS CORPORATION OF AMERICA
Dept. C9-5, 718 Beacon Street, Boston, Mass.
In Canada, write Electronics Corporation of America (Canada) Limited, Box 111, 98 Advance Road, Toronto 18.

Send Bulletin CP21 on Flame Failure Explosions

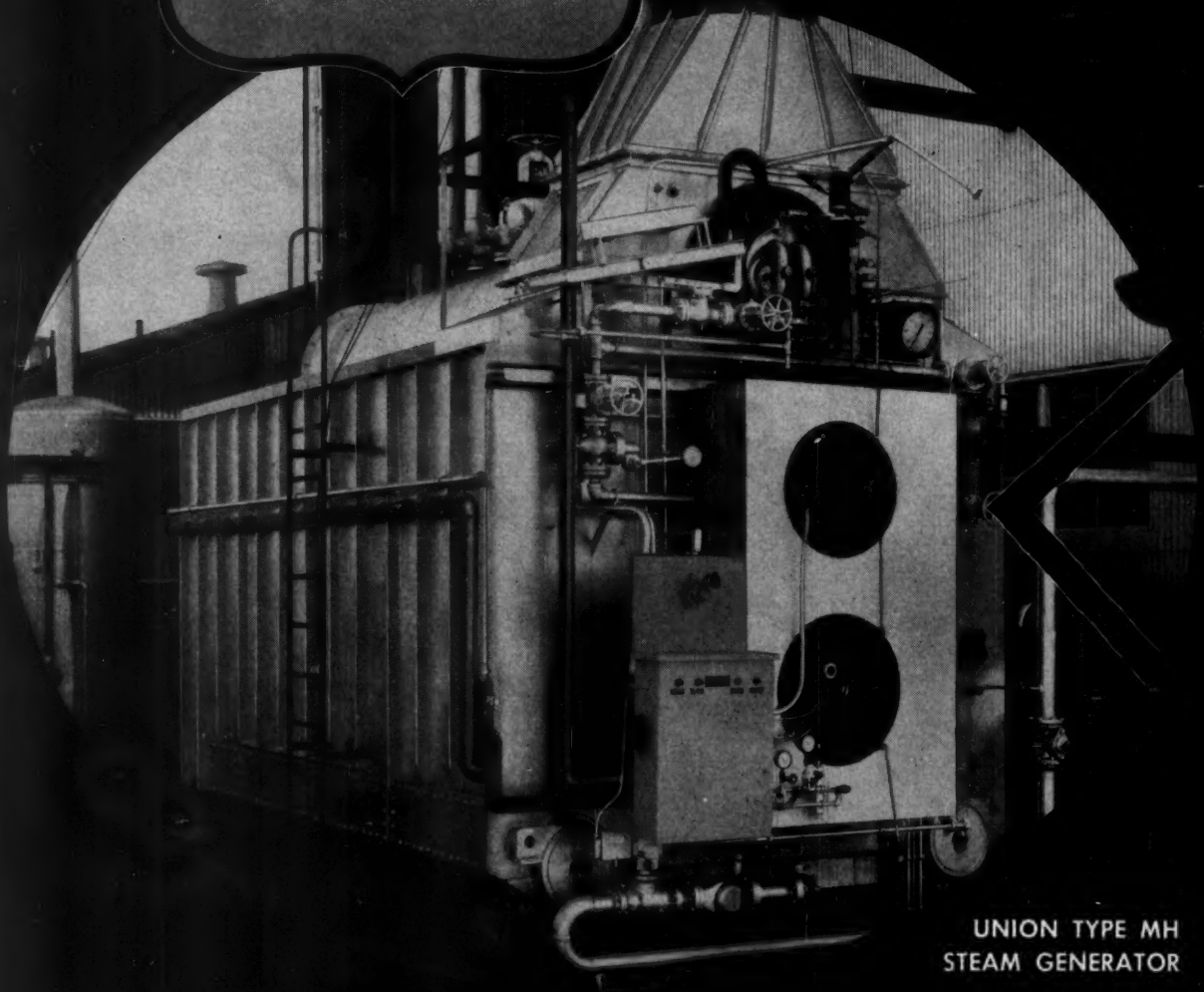
NAME _____

FIRM _____

ADDRESS _____

the PACKAGED BOILER

UNION



UNION TYPE MH
STEAM GENERATOR

Compare! Make a feature-by-feature appraisal of the modern Union Type MH Steam Generator. Here's the packaged boiler most apt to be **right** for you.

That's because the compact, 3-drum MH has not only been patterned after Union's larger, 16-year successful, field erected Type H, but it can be equipped to fulfill multitudes of steam requirements. No other packaged unit is so adaptable in meeting individualized needs within the 10,000 to 40,000 lb/hr range. No other boiler will do so much for **you.**

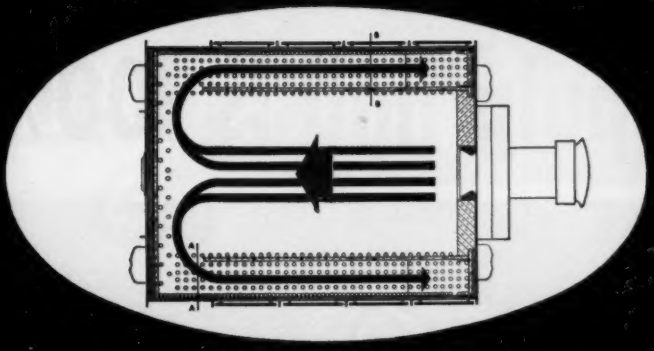
SEE FOR YOURSELF!

FREE: Illustrated, 16-pg Bulletin MH 354 will be mailed on request. Containing cut-away illustrations, installation photos, tube arrangement layouts and specs, it will give you the complete story. Write for your copy today.

UNION IRON WORKS

ERIE, PENNSYLVANIA

that "HAS EVERYTHING"



HIGH MASS GAS FLOW, HIGH HEAT TRANSFER

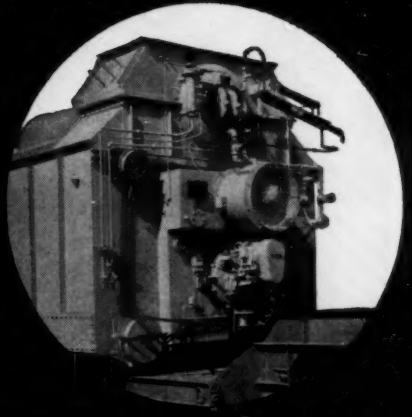
The straight-through gas flow over the divided tube banks requires furnace baffles only. Tube pattern provides high heat transfer and low exit temperatures without the higher draft losses of a staggered tube arrangement.

BALANCED, 3-DRUM DESIGN

A bare tube view gives you at-a-glance proof of the basic soundness of the MH design. There are no long furnace floor tubes, water wall headers nor circulator connections to impede circulation. The MH can be brought on the line quickly and will readily handle fluctuating steam demands.

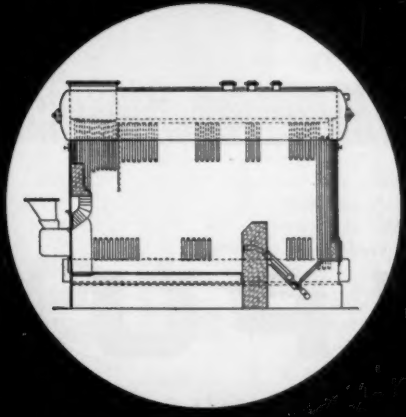
DIVIDED TUBE BANK, TANGENT TUBE WALL CONSTRUCTION

Divided tube banks enclose a self-contained furnace and provide multiple tube rows between furnace and casing walls. This arrangement and the use of tangent tubes in outer rows bring about minimum radiation losses and low casing temperatures.



MEETS PRESENT AND FUTURE FUEL NEEDS

The MH Steam Generator can be equipped for oil or gas firing or both . . . or for burning refuse or by-product fuel. It can be furnished with either fully automatic, semi-automatic or manual ignition and combustion control.



READILY ADAPTABLE TO STOKER FIRING

The MH is so designed that it may easily be converted to stoker firing . . . without requiring any changes in pressure parts. Installation is simple. With the furnace floor removed, only minor alterations need be made to the draft equipment.

OUTFITTED TO MEET YOUR SPECIAL REQUIREMENTS

Superheaters, of the pendant type, with or without control, can be installed to meet total temperature requirements. Heat recovery equipment is supplied when needed. High pressure units are also available for special applications.

Furnace Tubing for C-E Recovery in pulp mill is 100% REPUBLIC

GIANT RECOVERY UNIT BOILER built by Combustion Engineering, Inc., uses 80 tons of Republic ELECTRUNITE Boiler Tubing to provide 16,800 square feet of heating surface. Unit operates at 450 psi with steam temperature at superheater outlet of 750°F. Consumption is 1,610,000 pounds of dry solids per day.

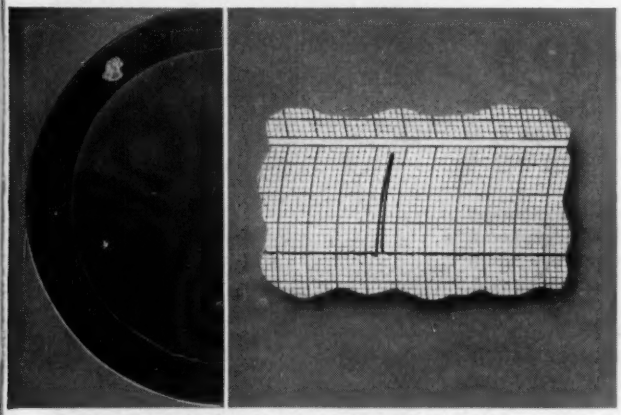
REPUBLIC

REPUBLIC STEEL

World's Widest Range of Standard Steels

Unit ELECTRUNITE

UNIFORM DUCTILITY OF ELECTRUNITE Boiler Tubing helps rolling-in. Tube ends are easily and securely rolled into tube holes in drum. Result: consistently tight, weeper-free joints plus maximum ease of installation.



HERE'S THE ULTIMATE IN TUBE PROTECTION. FARROWTEST®, an electronic method of checking tubing for injurious defects, is exclusive with Republic. The oscillograph (shown above) records a defect registered on the macrograph. The presence of the defect passing through the FARROWTEST equipment automatically stops the machine, allowing the operator to mark and reject the tube. Send coupon for details.

Eighty tons, approximately 24,000 linear feet of Republic ELECTRUNITE® Boiler Tubing went into the boiler of one of the nation's largest C-E Recovery Units, recently installed for one of the South's largest pulp and paper plants.

Designed and built by Combustion Engineering, Inc., New York, the giant unit has a twofold purpose: to recover chemicals from spent liquor in the pulp mill; and to produce as much steam as possible from the boiler portion of the unit, using solids taken from the liquor as fuel. Since these functions are vital to both operation of the pulp mill and disposal of spent liquor, dependability and efficiency of the boiler are of paramount importance.

And that's where ELECTRUNITE excells.

ELECTRUNITE Boiler Tubes have a world-wide reputation for efficiency and reliability. The electric welding process, by nature, produces precise, uniform wall thickness assuring uniform, efficient heat transfer all around and throughout the length of each tube. Dependability cannot be threatened by longitudinal thin spots. Further, all ELECTRUNITE Tubes are hydrostatically or electrically tested to make certain of maximum performance in each length in any quantity.

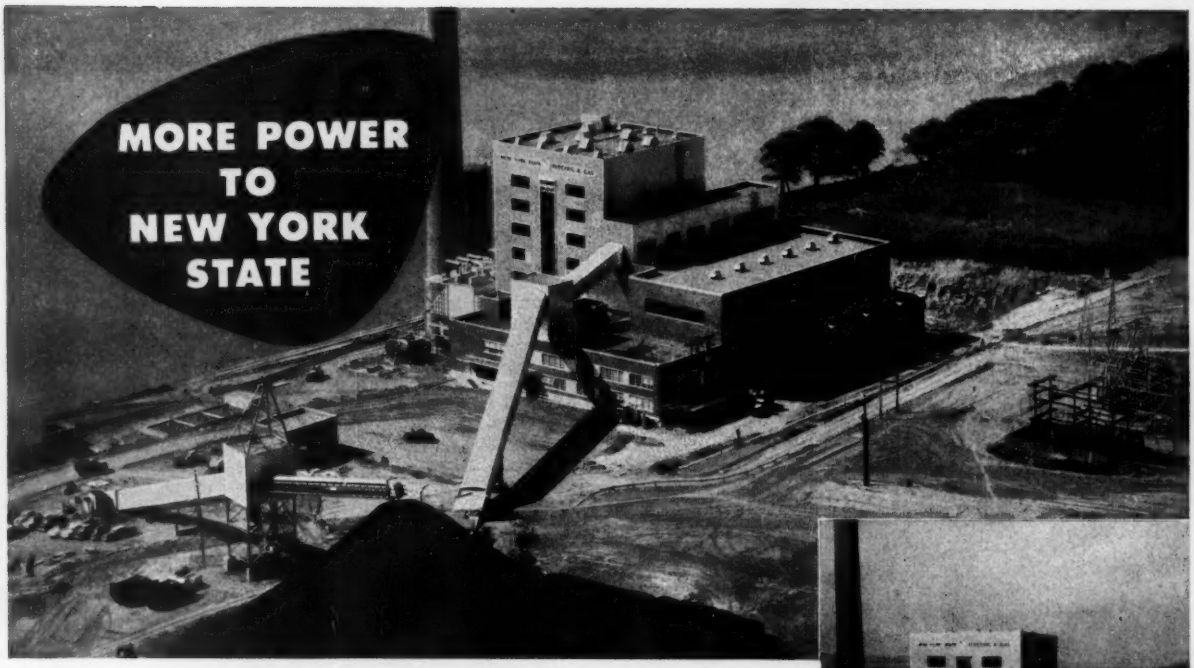
Get all the facts on ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubing from your local Republic Representative. Meantime, mail the coupon for your free copy of our handy wall chart entitled, "Care and Maintenance of Boiler Tubing." It's a handy guide to protecting your boiler installation from corrosion, erosion and physical wear and tear. Do it today.

REPUBLIC STEEL CORPORATION
Dept. C-1707
3144 East 45th Street, Cleveland 27, Ohio

Please send:
- ☐ Illustrated booklet giving facts on ELECTRUNITE Boiler Tubes
- ☐ 8-page brochure on Heat Exchanger Tubing— carbon steel ☐ stainless steel ☐
- ☐ Handy wall chart on Care and Maintenance of Boiler Tubes
- ☐ Data on exclusive FARROWTEST

Name_____ Title_____
Firm _____
Address _____
City_____ Zone____ State_____

STEEL
and Steel Products

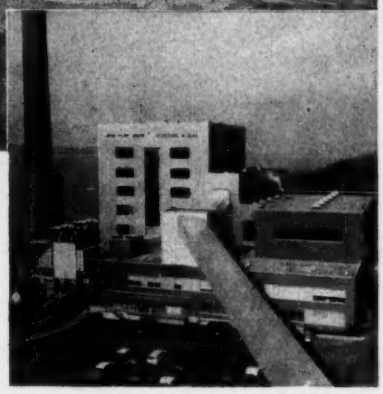


S-A COAL CONVEYOR SYSTEM IS PART OF A NEW APPROACH TO *Kilowatt Economy!*

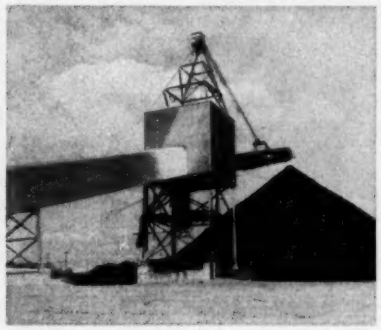
The power industry will watch with interest, the operation of the New York State Electric and Gas Corporation's giant new Milliken Generating Station at Cayuga Lake, New York.

An active outdoor storage pile with continuous and automatic reclaiming replaces large indoor bunkers in the STEPHENS-ADAMSON engineered coal handling system designed and built for this customer in collaboration with their engineers and consultants, Gilbert Associates, Incorporated. A 900 ton per hour conveyor handles the fuel from car dumper to active storage. Two 300 ton per hour belts convey the coal from the active storage to the small plant bunkers. Continuous flow from outside storage to bunkers is electronically controlled to maintain constant bunker level. The entire coal handling system is operated by only three men.

S-A experience in building conveyor systems for the power field may well be one of the keys to success in this venture in economical coal handling at Milliken Station.



S-A double belt conveyor leads from yard storage pile to station transfer point, thence to direct discharge into coal bunkers. Vibratory feeders beneath pile supply crushed coal to electronically controlled belts.



Coal is belt conveyed from car dump hoppers containing two apron feeders to this hinged boom station. Boom discharges to yard storage pile. These facilities are manually operated on intermittent schedule.

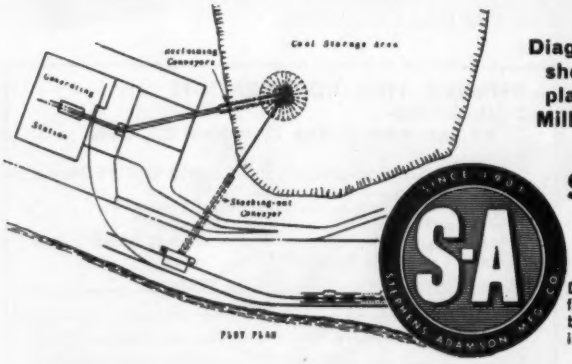


Diagram drawing shows overall plan layout of Milliken station.

STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Ave., Aurora, Ill.—Los Angeles, Calif.—Belleville, Ontario.

ENGINEERING DIVISION
Designers and manufacturers of all types of bulk materials conveying systems.

STANDARD PRODUCTS DIVISION
A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

SEALMASTER DIVISION
A full line of industrial ball bearing units available in both standard and special housings.

Progress in turbine-generators

How General Electric provides maximum reliability in turbine-generator armature insulation

About preceding page illustration

HIGH-VOLTAGE TESTS TO DESTRUCTION are used to determine how much G.E.'s armature insulation can withstand. Forced to carry voltages far above their rating, test bars first develop corona streamers, then finally fail, enabling engineers to discover the insulation's actual voltage strength.

99.85% service availability highlights performance of turbine-generator armature insulation

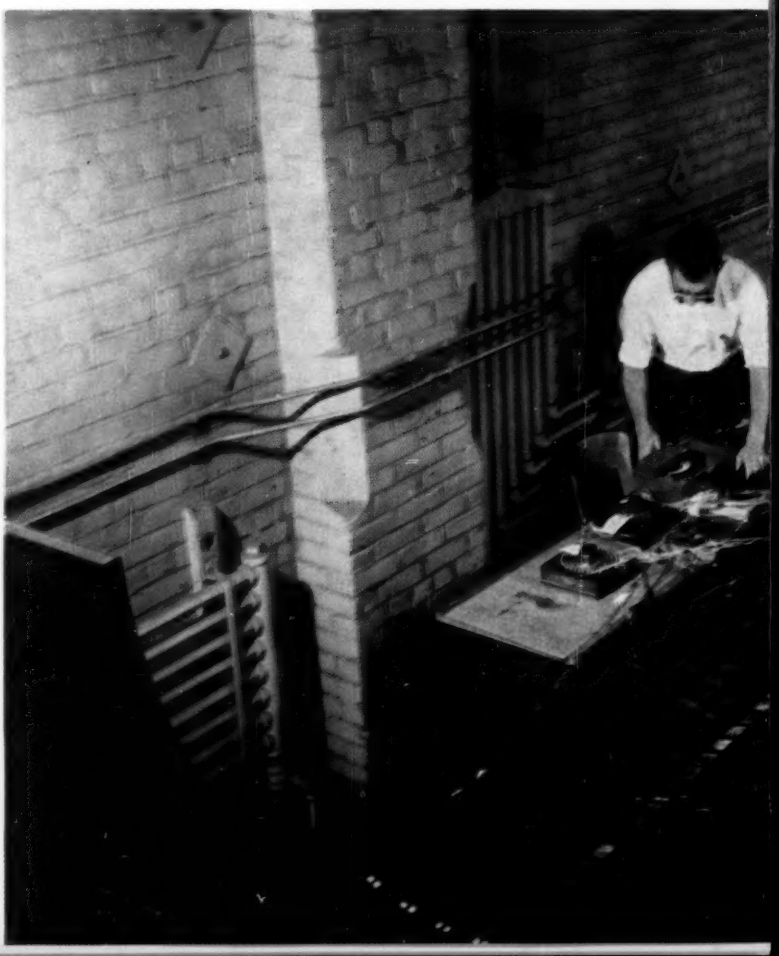
G-E design combines both electrical endurance and mechanical toughness

Primary among the many factors affecting a turbine-generator's long-term service availability is the quality of its armature insulation. It must withstand high voltages over long periods of time. And at operating temperatures it must endure the variable stresses caused by differential thermal expansion and contraction within the generator.

General Electric insulation measures up to these requirements with an already proved service availability of 99.85 percent in turbine-generators.

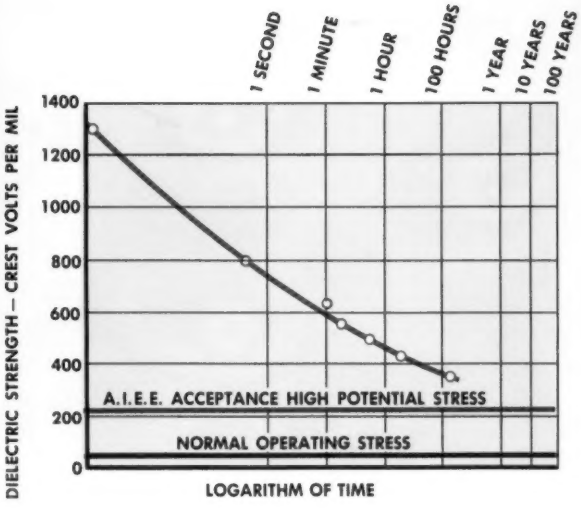
Progress in other areas of generator development often influences the performance of insulation. Larger capacities, higher voltages, different cooling methods all present new problems. To make sure that insulation quality keeps pace, each new generator development includes rigorous tests of insulation under the new set of conditions.

The illustrations on these pages show typical insulation tests constantly under way at General Electric's turbine plant.

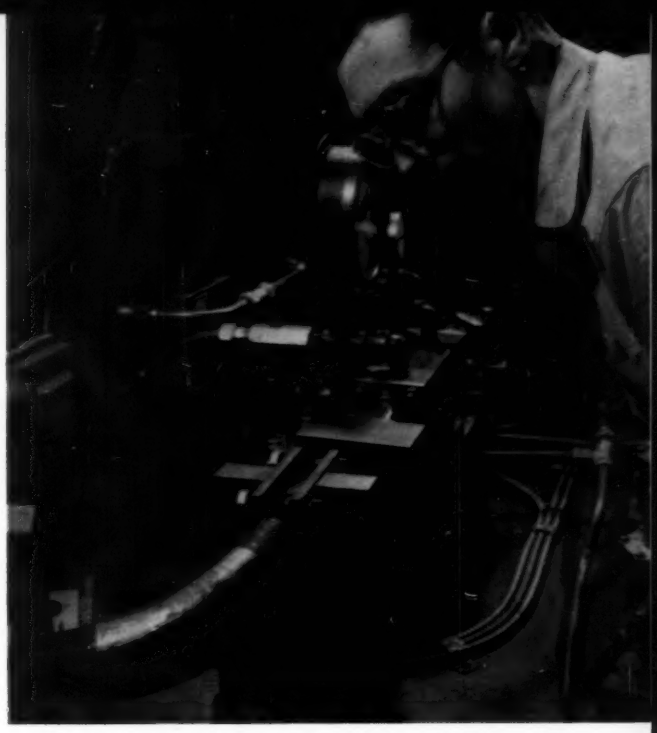


G-E APPLIED RESEARCH is typified by this full-size armature bar test. Here, General Electric engineers find out how well insulations can withstand the mechanical stresses caused by differential thermal expansion and contraction within an operating generator.

To simulate actual operation in this special 17½-foot core section, high currents are run through full-size stator conductors to build up heat; then are shut off while the apparatus is cooled by blowers. This procedure can reproduce ten years of anticipated operating stress cycles in just four months of testing. This important test provides an accurate means of evaluating both present insulation materials and new ones under development.



HIGH-VOLTAGE ENDURANCE of G-E insulation over long periods of time is graphically illustrated here. This record invites comparison with that of any other turbine-generator insulation in service today.



FLEXING TEST determines the insulation's ability to withstand bending caused by expansion and contraction or by short circuits. Here, a G-E engineer evaluates performance of the critical end portion of an armature bar.

EVERY GENERATOR leaving the factory has passed a series of searching high-potential tests. A sample bar, selected at random, is tested to failure. For quality control, each bar is separately subjected to voltage stresses of more than five times normal operating stress. When installed in the generator, the bar is again tested at voltages producing 3½ times normal operating stress. Immediately following generator running tests, windings are "hot high-potted" at operating temperatures, and finally tested at room temperature just prior to shipment.

Leader in Turbine-Generator Progress

GENERAL ELECTRIC

G-E engineers are developing new insulations for larger machines

In the picture above, a G-E development engineer is shown inspecting one of tomorrow's insulations now being developed in the Large Steam Turbine-Generator Department's Materials and Process laboratory. A special processing mill is being used to treat the new type insulating material. The rollers increase homogeneity and orient the structure for improved mechanical and electrical properties.

One of the new materials coming out of this applied research is Micapal, a mica-based synthetic insulation which shows marked improvements in dielectric strength, thermal conductivity, heat endurance, and mechanical strength. The first generator utilizing Micapal has been in commercial operation for more than two years.

Micapal and other insulations now under development will help continue General Electric's record of turbine-generator progress.

If you would like more information on G-E turbine-generator development, contact your nearest G-E Apparatus Sales Office, or write for Bulletin GER-1047, "Research and Development in the Field of Turbine-Generator Prime Movers in the General Electric Company." Large Steam Turbine-Generator Department, *General Electric Company, Schenectady 5, N. Y.*

254-28

Progress Is Our Most Important Product

GENERAL ELECTRIC

Now—CORROSION PROTECTION at a BUDGET PRICE

● Here is a deaerator of Schaub quality, engineered on new principles, designed especially to put effective boiler feed water deaeration within price reach of the small to medium size plant.

These plants, from 3,000 to 30,000 lbs/hr., often running at low pressure, are likely to have the same corrosion and high maintenance costs as their "big brothers". In fact, "Return Line Corrosion" is *most apt* to occur in *low pressure* heating systems even though raw water make up is negligible. For such plants, as well as for high pressure installations, the Schaub .03 Deaerator offers an effective and economical solution that will pay for itself many times over.

The Schaub .03 Deaerator operates *fully vented* at atmospheric pressure. Premium cost construction is eliminated, maintenance and operating costs are reduced to a minimum. Liberated, non-condensible gases escape *immediately* and *completely*. At the same time, simple but effective spray-contact vent condensing, prevents wasteful steam vapor loss. Pin-point temperature control, "live-action" heating and rust-proof chromasoid lining are exclusive features.

FRED H. SCHAUB ENGINEERING COMPANY

2105 South Marshall Boulevard ● Chicago 23, Illinois

Get the Full Story on This More Efficient Low Cost Deaerator — Write for Bulletin 1300

Simple though it is, there's much more to the Schaub .03 Deaerator than can be told here. Bulletin 1300 is filled with information for the operating or consulting engineer responsible for economical and efficient deaeration of boiler feedwater. Tells the "hows" and "whys" of deaeration, especially for the small to medium size plant, explains how the Schaub method differs and its advantages in performance and low cost. Mail the coupon today.

NOTE: The Schaub .03 Deaerator is designed for boilers up to 30,000 lbs. per hour. For capacities up to 100,000 lbs. per hour at .005 cc/liter "zero-oxygen" removal write for Bulletin 575, describing the Schaub Zero-Oxygen Deaerator.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

NAME.....

COMPANY.....

ADDRESS.....

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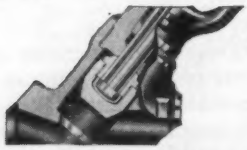
EDWARD DESIGN FEATURES assure

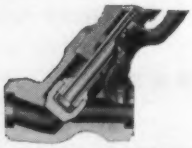
ALL ARE "FIRSTS"...MANY ARE "EXCLUSIVES" ...EACH MEANS A BETTER VALVE

INCLINED STEM VALVES First to build inclined stem forged globe stop valves and check valves. Edward construction eliminates turbulence, cuts wear, reduces pressure drop 25 to 50 per cent.

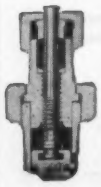
RADIUS STEM HEADS Radius of stem head assures application of closing load at center of disk. Curvature of inside of disk, in contact with stem head, centers disk for sure, tight seating.



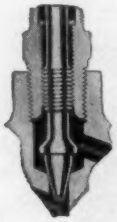
FOOLPROOF STEM BACKSEATS Spherical stem or disk nut surface contacts taper bonnet surface to make a pressure-tight backseat. Exclusive with Edward.



UNIVALVE* BONNET JOINT Patented leak-proof welded body-bonnet joint assures perfect alignment of working parts, permits disassembly if ever necessary.

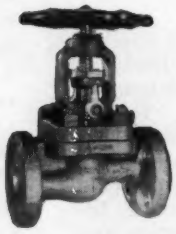


EVALIZING* Exclusive Edward process electro-plates parts with wear-resistant metallic lubricous material. Reduces wear and friction between internal valve parts 50 per cent or more. Ideal for temperature service.



TAPER THREAD BONNET JOINT Taper threaded joint in small forged gage valves gives tight seal, withstands extreme pressures.

CROSS ARM IMPACTOR* HAND-WHEEL Now the famous Edward Impactor principle is applied to small valves. Easy-to-grip cross-bar delivers 2.8 times the closing load of ordinary handwheels. No wrenches or extensions needed.



FORGED STEEL FLANGED VALVE DESIGN Edward designed first forged valves with symmetrical, uniform wall thickness. Eliminates thermal distortion and stress, cuts needless weight.

SWING BOLT RETAINER New type retainers keep packing gland swing bolts in place on integral forged support pins, yet out of way for easy repacking.

NO-BONNET INSTRUMENT VALVE No chance for bonnet joint leak with these compact all forged valves for toughest instrument line service.

WELDED-ON FLANGES Edward patented first valve constructions using welded flanges. Permits super strong drop forged bodies.

EVALPAK* PACKING Edward developed first asbestos-graphite packing with special processing to prevent stem pitting. Die molded, wire supported, low operating torque.

OTHER EDWARD FIRSTS! **Patented EValthrust* yoke bushings . . . Impactor* handwheels . . . Closure indicators . . . Streamlined cast steel body contours . . . Three-point disk guiding . . . Self-centering disk throttling lip . . . Free floating tubular disk-piston . . . Edward Equalizer* . . . Edward Pressure-Seal design . . . Integral seats . . . Seat-located guide ribs in gate valves . . . Hour-glass type disk-piston . . . Separated feedline stop-check valves . . . Part interchangeability in stop, check and non-return valves.**

Registered trade name of Edward Valves, Inc.

ROCKWELL-BUILT EDWARD VALVES

YOU top FORGED STEEL VALVE VALUE

DON'T SETTLE FOR LESS OR PAY MORE

Forged Steel valves, because they are small, sometimes don't get the attention they deserve when specifications are drawn.

But the smallest valves, if not equal to the service to which subjected, may be the most troublesome. Therefore, it pays to take time to analyze design features and to study actual service records.

If you do, you'll find that Edward forged steel valves are the most copied in the field. You'll find that dozens of features that were Edward "firsts" are now accepted as industry standards. But you'll also find that there are still many patented features exclusive with Edward.

Edward pioneered *forged steel* valve construction, and Edward design developments have consistently been a step ahead of mounting service requirements, piling up outstanding service records in some of America's most famous power plants and process installations.

For steel valves for pressures from 150 to 7500 lb, expect the best *first* from Edward.

Always specify Edward. Only Edward Valves Equal Edward Quality and Performance.

New design Fig. 444-448 and 944-948 series *all forged steel* globe and angle valves, 600 and 1500 lb sp, bolted or union bonnet, screwed or welding ends. **Fig. 444 illustrated.**

All forged steel welded bonnet Univalves*, 1500 and 2500 lb sp. Integral Stellited seat, Stellited disk, chrome-moly body, with permanent or removable backseat for disassembly in the line. **Fig. 2224 illustrated.**

Another Product

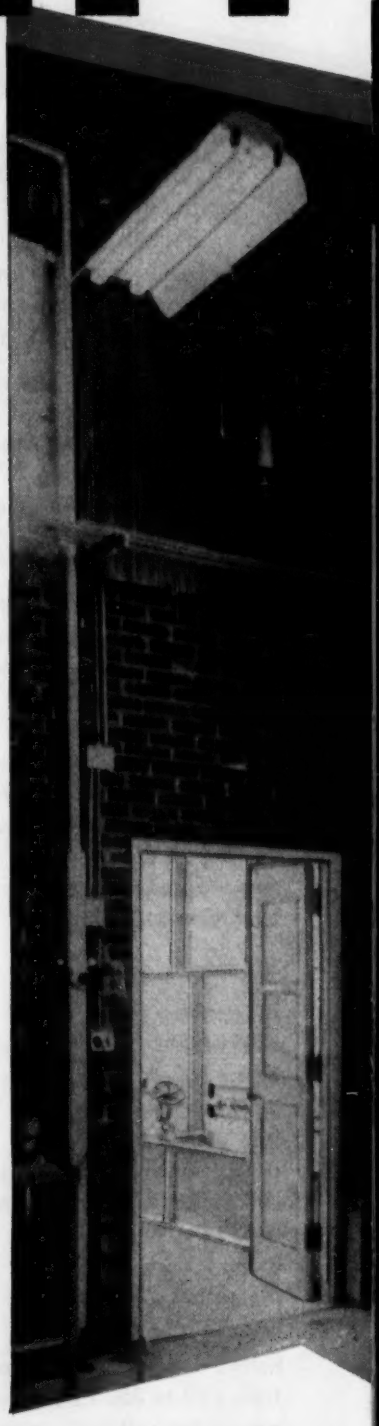
Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1230 West 145th Street, EAST CHICAGO, INDIANA

ERIE CITY

For Future---
Stoker Firing



• Now it's possible to obtain the advantages of completely packaged gas and oil fired steam generators and still provide for future stoker firing. Erie City VL's are designed as a true package with furnaces properly proportioned and arranged for easy conversion to stoker firing.

These Erie City VL type package steam generators are arranged for either forced or induced draft operation and are shipped shop assembled with brickwork installed. Controls and Burners are piped, wired and mounted — and remember — Erie City package boilers are Factory Fire Tested prior to shipment. All this ready for your basic service connections plus having a boiler designed for the future installation of an Erie City stoker.

• *When American Synthetic Rubber Corporation of Louisville, Kentucky modernized its steam facilities, they turned to Erie City Packaged Power. Installed there are three 25,000 pounds per hour VL type packaged steam generators complete with Erie City steam atomizing combination gas and oil burners and arranged for the future installation of Erie City Underfeed Stokers.*

For complete VL boiler data ask for SB-432.

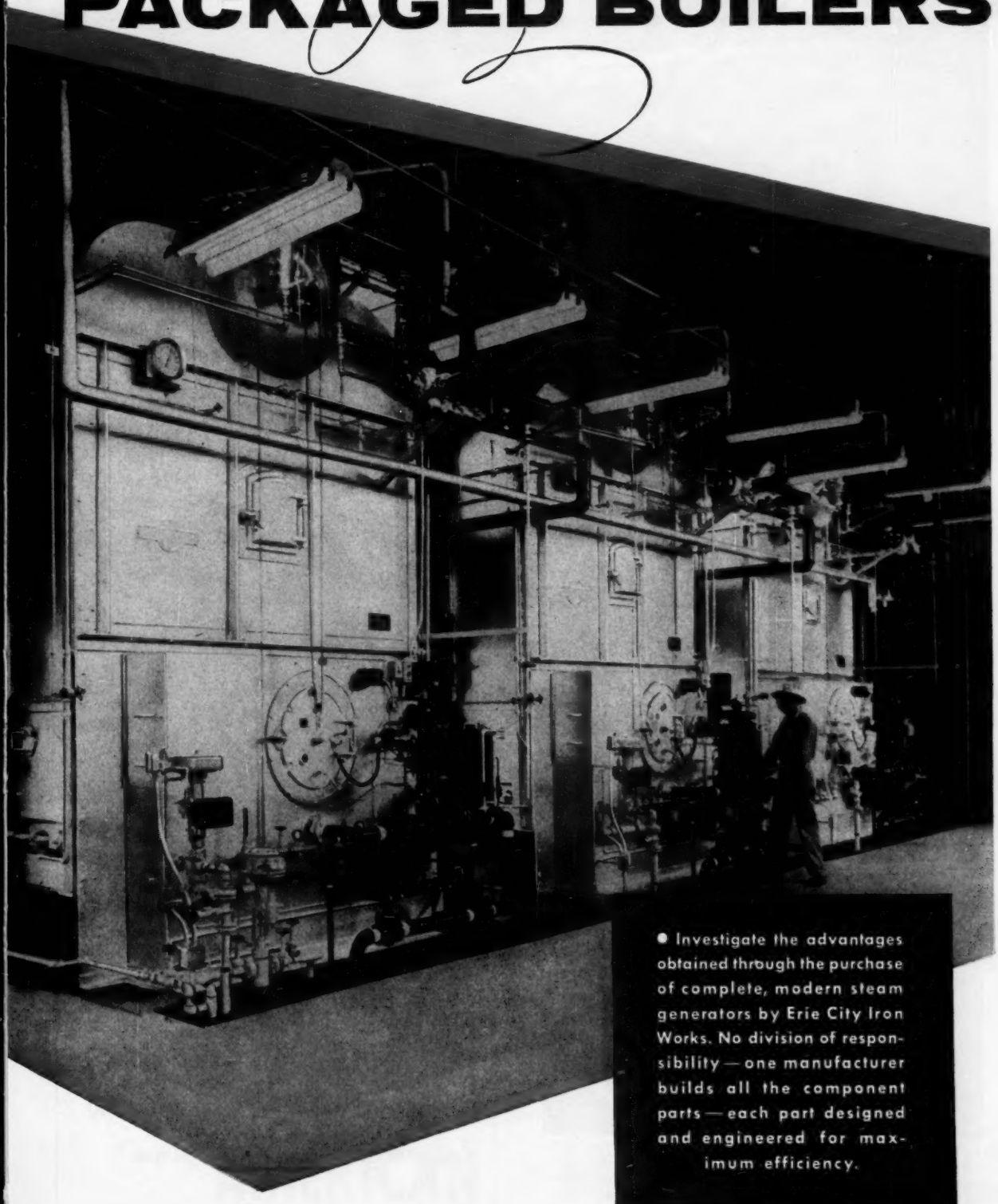
ERIE CITY
116 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

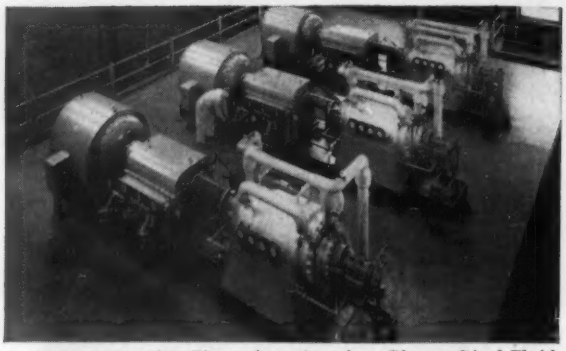
-Oil and Gas-
PACKAGED BOILERS



● Investigate the advantages obtained through the purchase of complete, modern steam generators by Erie City Iron Works. No division of responsibility—one manufacturer builds all the component parts—each part designed and engineered for maximum efficiency.

Potomac Electric Power

The Potomac River Plant is one of three PEPCo electric-power giants serving Washington, D.C., and nearby areas of Maryland and Virginia.



At PEPCo's Benning Plant, three American Blower Gyrol Fluid Drives provide adjustable-speed control for boiler-feed pumps. Each is rated at 1250 hp at 3600 rpm. Six Gyrol Fluid Drives for the same application are installed at the Potomac River Plant — each is rated at 1750 hp at 3600 rpm.

American Blower Forced Draft Fans are also installed at the Potomac River Station. Fans on Boilers 1 and 2 are rated at 113,000 cfm @ 100°F @ 11.0″ sp @ 1150 rpm. Fans on Boilers 3 and 4 are rated at 111,000 cfm @ 100°F @ 17.5″ sp @ 700 rpm.

records all-time peak load:

810,000 kw

Potomac Electric Power Company's new high peak load of 810,000 kw in 1955 marked a 9.3% increase above the peak of the previous year. Although it was appreciable, the boost is only the beginning.

The coming years will see the continuation of an expansion program in which Potomac Electric Power Company has been engaged since the close of World War II . . . to better serve its more than 320,000 customers in the District of Columbia, and areas of Maryland and Virginia. During the 14-year period, 1947 to 1960, additions to PEPCo's electric plant are expected to total $320 million.

As an important part of its power build-up, PEPCo relies on American Blower Mechanical Draft Fans for efficient air handling and Gýrol Fluid Drives for smooth power transmission.

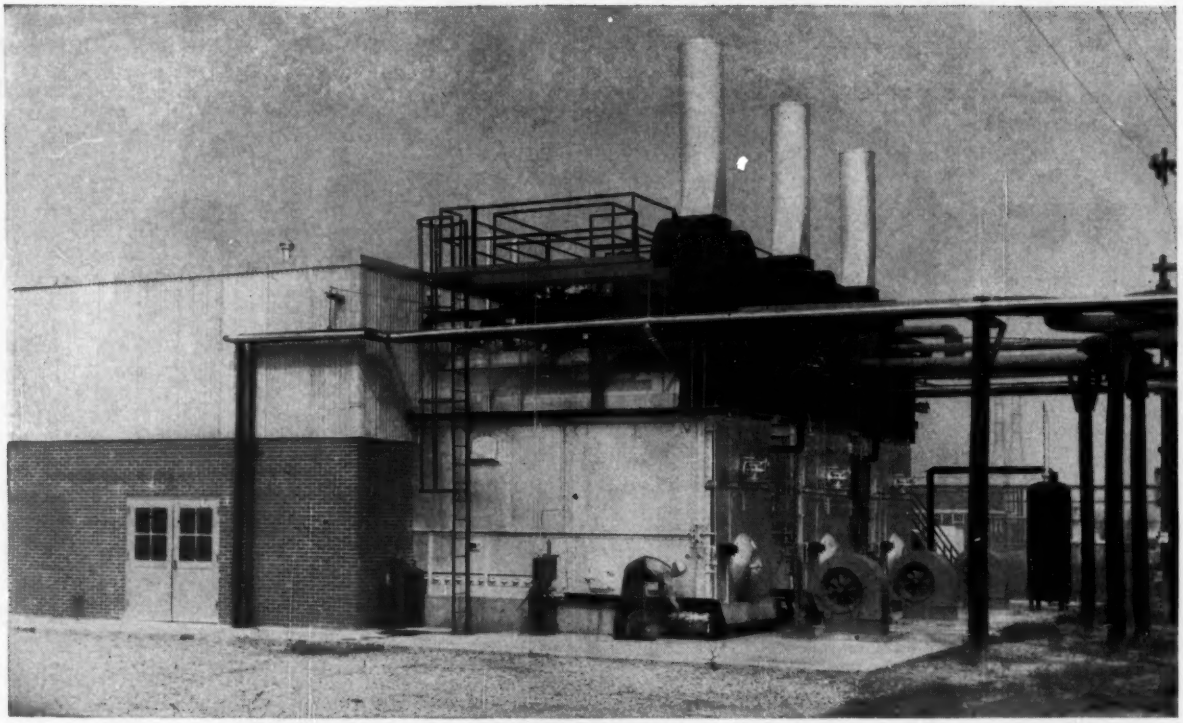
Like PEPCo, many other progressive utilities depend on American Blower equipment to meet rigid power-plant demands. Perhaps we can serve *you*, too. Call our nearby branch office for full data on our Mechanical Draft Equipment, Fly Ash Precipitators, Heavy Duty Steam Coils, and Gýrol Fluid Drives for boiler-feed pump and fan control.

American Blower Sirocco Induced Draft Fans service four boilers at the Potomac River station. Latest fans are rated at 160,000 cfm @ 250°F @ 18.0" sp. @ 667 rpm.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American-Standard

AMERICAN 75th ANNIVERSARY YEAR **BLOWER**



COMBUSTION CONTROLS GO OUTDOORS to help cut steam costs at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. The three 27,000 lbs./hr. gas or oil fired boilers operating at 175 psi generate steam for heating and processing.

"Big Station" Combustion Controls

Metering-Type Republic Control System Saves Fuel, Enables Boilers to Handle Fast Load Changes Quickly and Smoothly at American Synthetic Rubber Corporation

Peak combustion efficiency plus fast control of widely varying loads—these were combustion control requirements at American Synthetic Rubber Corporation's new packaged boiler plant near Louisville, Kentucky. To meet them, a metering-type combustion control system was specified instead of the "off-on" system usually furnished with packaged boilers. This system contains all of the basic control elements found in large installations and has all of the operating refinements common to large plants.

Is this metering-type control system worth its premium price? Flue gas tests made at various ratings conclusively answer the question with an emphatic YES. Combustion efficiency exceeds what similar packaged installations are delivering — and smoother operation is preventing chain-of-event troubles that frequently are caused by improper boiler operation. American Synthetic expects the controls to pay their extra cost in just a few years through fuel savings alone.

REPUBLIC FLOW METERS CO.

HOW METERING SYSTEM AT AMERICAN SYNTHETIC SAVES FUEL

Unlike most packaged boiler control systems, the Republic Combustion Control System at American Synthetic continuously measures both fuel and air inputs. Changes in fuel pressure, for example, which change the rate of fuel feed are detected immediately and automatically compensated for. Proper fuel-air ratio is maintained automatically at all ratings for maximum combustion efficiency.

Fast load changes are common in the plant with fluctuations varying as much as 8,000 lbs./hr. Rapid control response with Republic's dash-pot stabilization which prevents "hunting" enables boilers to meet new steam demands quickly and smoothly. Steam pressure and draft are held constant even during changing loads by the controls.

CONTROL SYSTEM CHANGES WITH FUEL

On oil firing, the controls operate on a steam flow-air correction system. For safety on gas firing, the controls are transferred to an air flow-gas flow correction arrangement which prevents over-firing in case air to the boilers is limited or blocked for any reason.

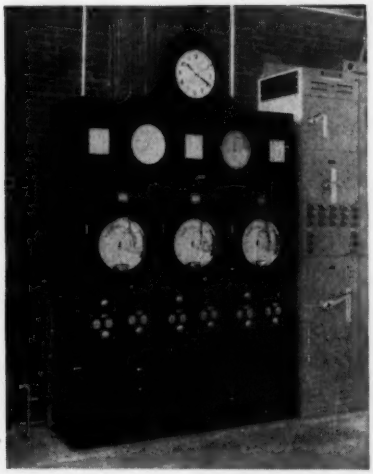
OPERATORS ARE ENTHUSIASTIC

The automatic correction feature of the Republic Controls eliminates time-consuming gas analysis and adjustments which would be necessary periodically with other types of controls. Correct operation of the boilers is easier, surer.

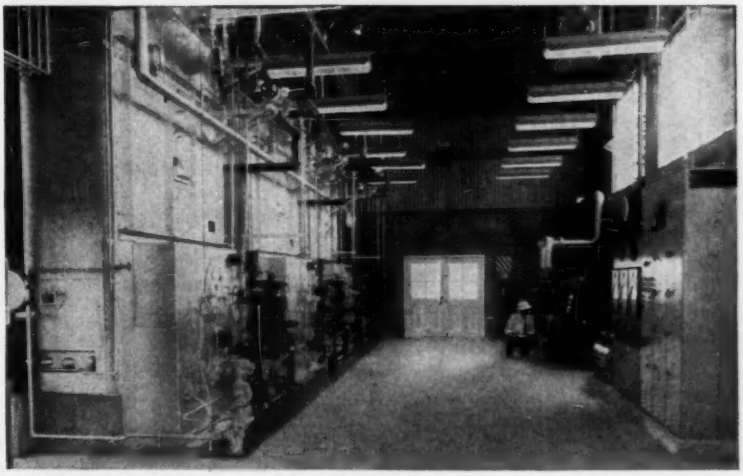
IF YOU ARE PLANNING ON INSTALLING PACKAGED BOILERS, find out how metering-type combustion control by Republic can improve efficiency, cut fuel costs and make operation simpler and easier. Contact your nearest Republic representative.

IF YOU ARE PLANNING *ANY* BOILER PLANT—any size, type or method of fuel firing — you can be sure of maximum efficiency with a Republic Combustion Control System engineered to exactly meet your needs. Write us when your problem is combustion control.

Pay Off for Packaged Boiler Plant

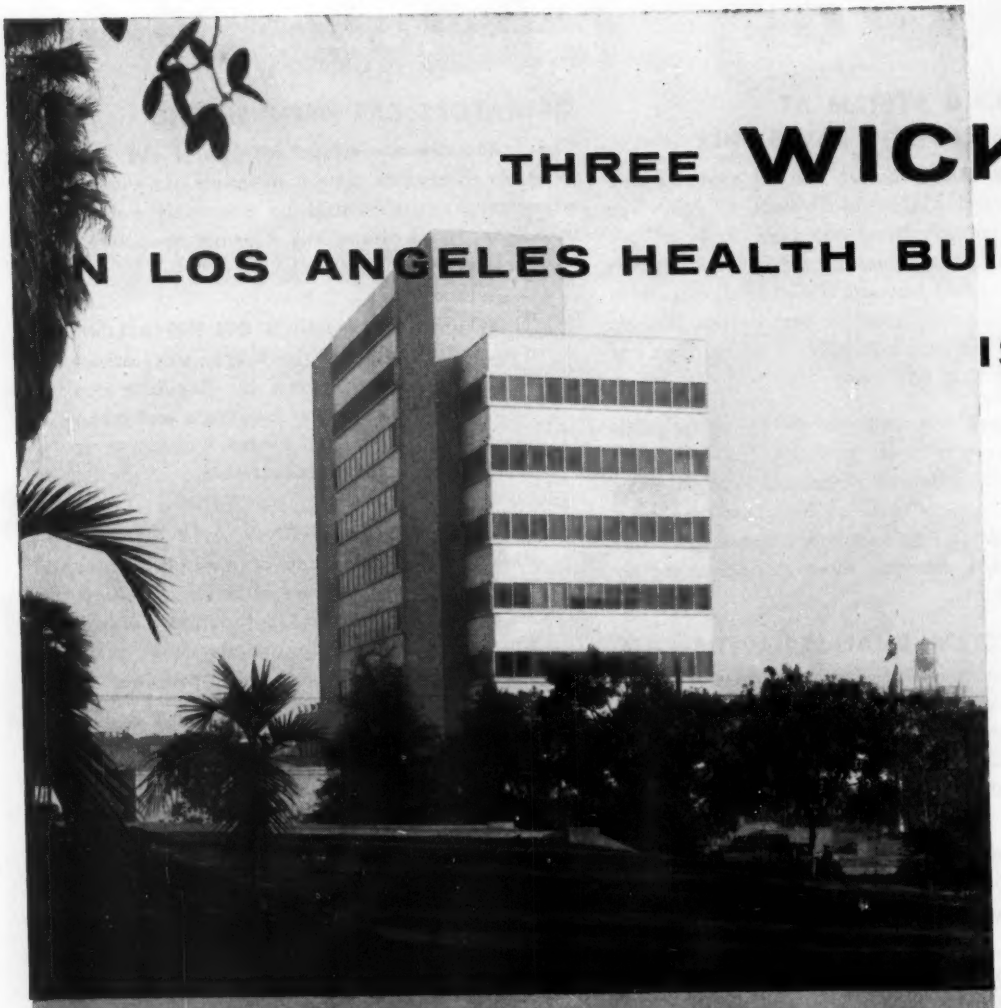


CENTRALIZED instrument and combustion controls on this Republic panel make checking and manual operation convenient and easy.



LOOKS EFFICIENT . . . AND IS. Interior view of the boilerhouse. All three boilers can be operated together or separately by means of control panel at right.

2240 Diversey Parkway • Chicago 47, Illinois



THREE WICKES

N LOS ANGELES HEALTH BUILDING

IS THE

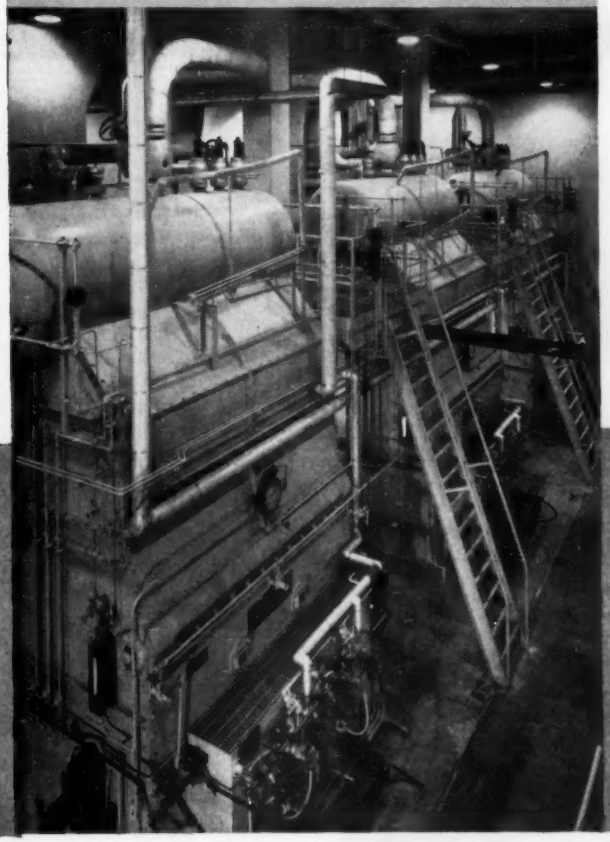
Architects: Lunden, Hayward, and O'Connor
Builder: Robert E. McKee General Contractor, Inc.

Housed in the striking modern structure shown here is a new clinic and health center for the city of Los Angeles Health Department. Beautifully equipped in every respect, the building has individual room thermostats to insure the exact desired temperature in each separate area . . . clinics, laboratories, medical sections, and others. To insure that the heating system responds immediately to these controls, the builders installed three dependable Wickes water tube steam generators. In addition to supplying the big nine-story Health Center with heat, the Wickes boilers also serve the entire City Hall building nearby, and the new Police Facilities building (a feature of this integrated Civic Center layout is that these buildings are connected to the Health Center by pedestrian tunnels, which are likewise heated by the Wickes boiler installation). Pictured at right is one of the modern health laboratories.

WICKES

STEAM GENERATORS WHERE DEPENDABILITY MOST VITAL FACTOR

The three Wickes boilers shown below supply heat for not only the Health Center but also the City Hall and new Police building.

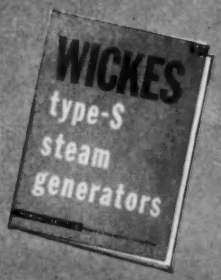


These 2-drum type-S Wickes steam generators are compact and efficient water tube units. Built to a design pressure of 160 psi, and with 3400 square feet of heating surface, each of these Wickes units is fired by 2 Multijet Combination gas and oil burners. They are quickly responsive to extreme fluctuations in load, and the large steam drums make certain of ample steaming capacity with dry steam. Wickes 2-drum type-S steam generators are readily adaptable to completely automatic control.

Other Wickes 2-drum, type-S, modern steam generators are available in the Series S1A and S2A. These units combine the water cooled furnace as an integral part of the boiler, adapting the high and low type furnace to the desired method of firing . . . coal, oil or gas. They are built to the design pressure of 725 psi; superheaters and recovery equipment are available.

WRITE FOR OUR NEW BROCHURE

Our new Catalog 53-2 contains complete information on Wickes 2-drum type-S steam generators. A general description is given of these modern efficient boilers, together with four insert pages of engineering drawings and data. We will also send you our complete facilities Bulletin No. 53-1.



161

THE WICKES BOILER CO.

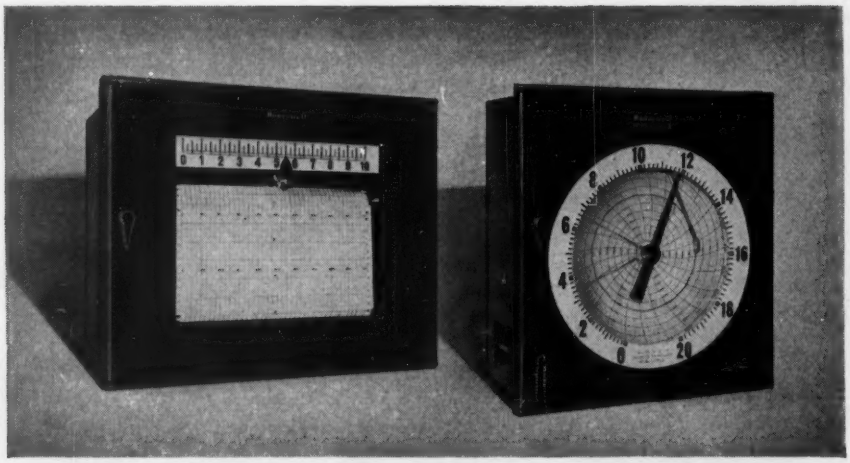
DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* • Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C.

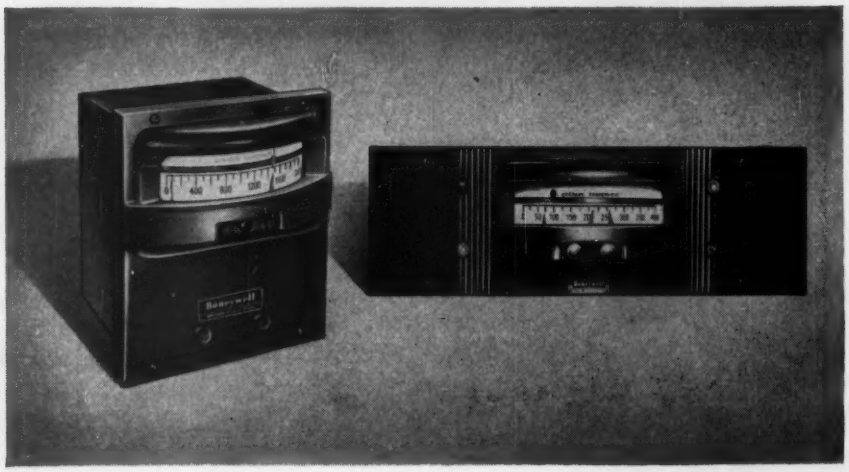
• *for accuracy,*
versatility, price

The Precision Class 15 Line of *ElectroniK* instruments has calibrated accuracy within ±.25% of scale span. Models include strip and circular chart recorders, Precision Indicators, circular scale indicating controllers, Vertical Scale Precision Indicator. Electric and pneumatic control from simplest to most complex types. Multi-point monitoring or recording of 2 to 400 separate inputs.

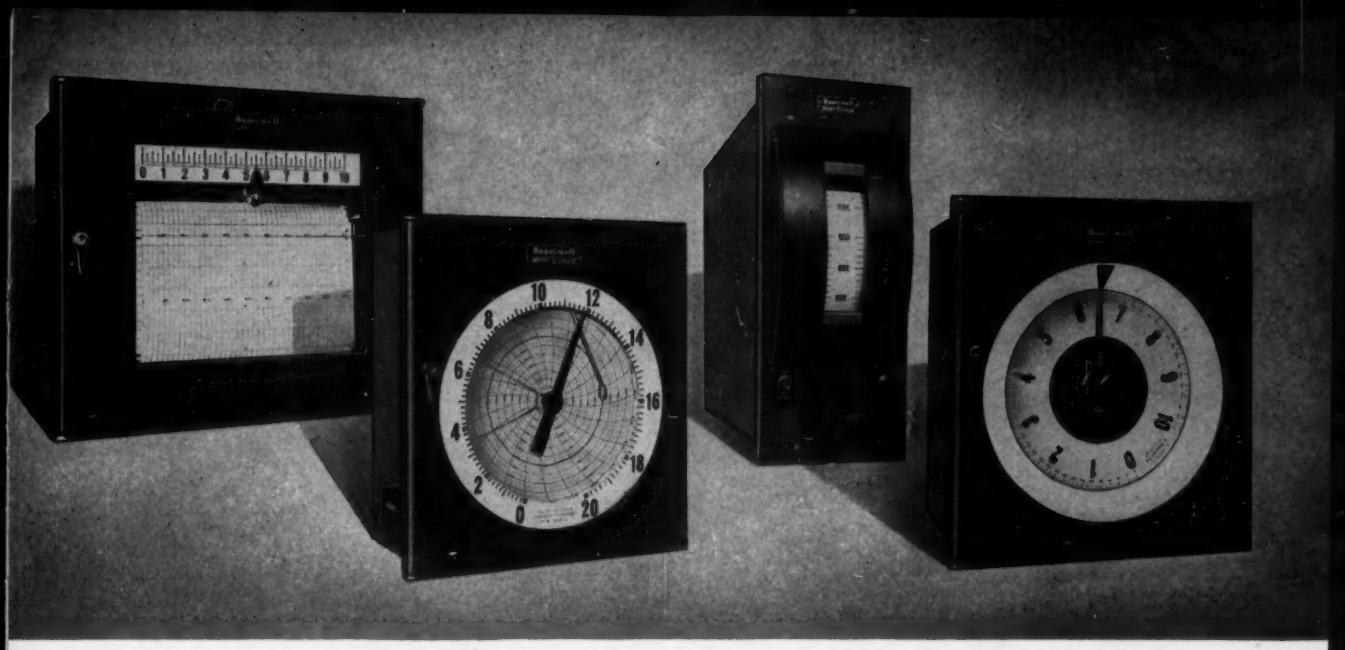
...Let your application decide



The Special Class 14 Line of *ElectroniK* instruments is calibrated to an accuracy of ±.5% of scale span . . . priced lower than the Precision line. Includes strip chart and circular chart recorders and recording controllers, also circular scale indicating controllers. Electric control of the contact, time-proportioning or position-proportioning type is available.



Millivoltmeter Instruments give dependable and accurate service, at low cost. High-resistance galvanometer circuit minimizes effects of varying length of extension wires. Plug-in unit design speeds servicing. *Pyr-O-Vane* controllers, in either horizontal or vertical case, give snap-action electronic vane control or pulse-type time-proportioning control.



which Honeywell instrument

fits your needs

GOT a temperature measurement or control job to handle? There's no need to "shop around." For from *one* source—Honeywell—you can be sure of getting exactly the right instrument to fit your needs.

This is the time-saving—and money-saving—way to choose instruments. You can choose from the most complete, most diversified line of pyrometric instruments on the market. Your selection can hit the application right on the button—giving you the performance you need at the price that fits your budget.

For the peak in precision and versatility, there's the "Precision" *ElectroniK* line. This is the pioneer "continuous balance" electronic instrument that thousands of plants and laboratories have used for many years. It's available in eleven basic models, and can provide automatic control action from the simplest to the most advanced types.

For less exacting applications, a new series of instruments—the "Special" *ElectroniK* line—is now available. They provide many of the forms of automatic control you can get with the "Precision" line. And they cost less . . . bringing *ElectroniK* performance within the reach of even wider areas of application.

For simplified indicating control, Honeywell offers a line of economical millivoltmeter instruments . . . *Pyr-O-Vane* controllers, with a variety of electric control forms . . . and *Protect-O-Vane* controllers for excess temperature safety cut-off.

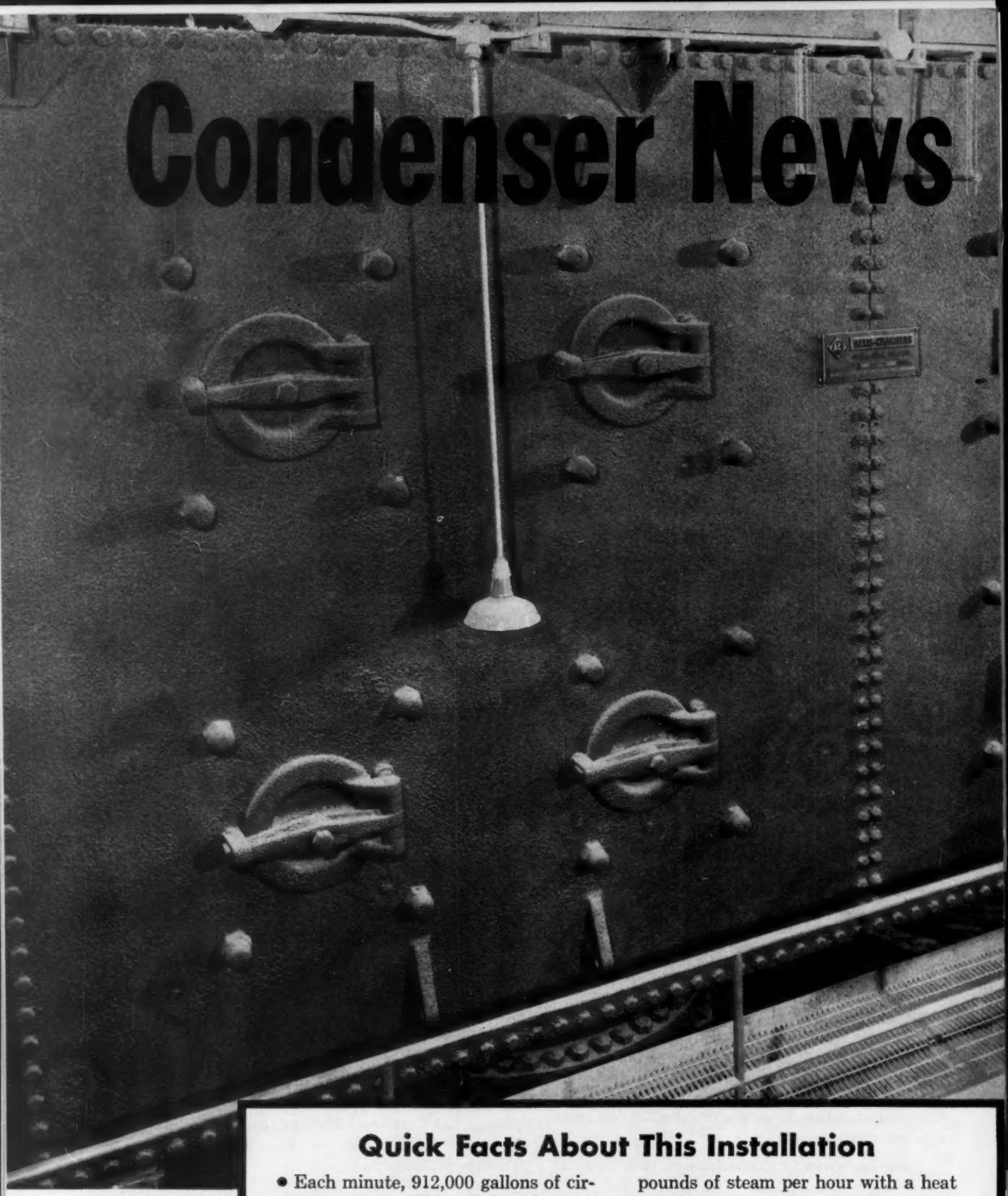
Your local Honeywell engineer will be glad to help you determine which type of instrument best fits the needs of your own application.

Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

Condenser News



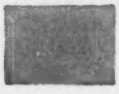
Quick Facts About This Installation

- Each minute, 912,000 gallons of circulating water will be used in the condensers . . . enough for a city of approximately 8,750,000 people.
- Each condenser will handle 979,000 pounds of steam per hour with a heat rejection rate to water of 930 million Btu per hour.
- About 500 miles of tubing went into the six 100,000-sq-ft condensers.

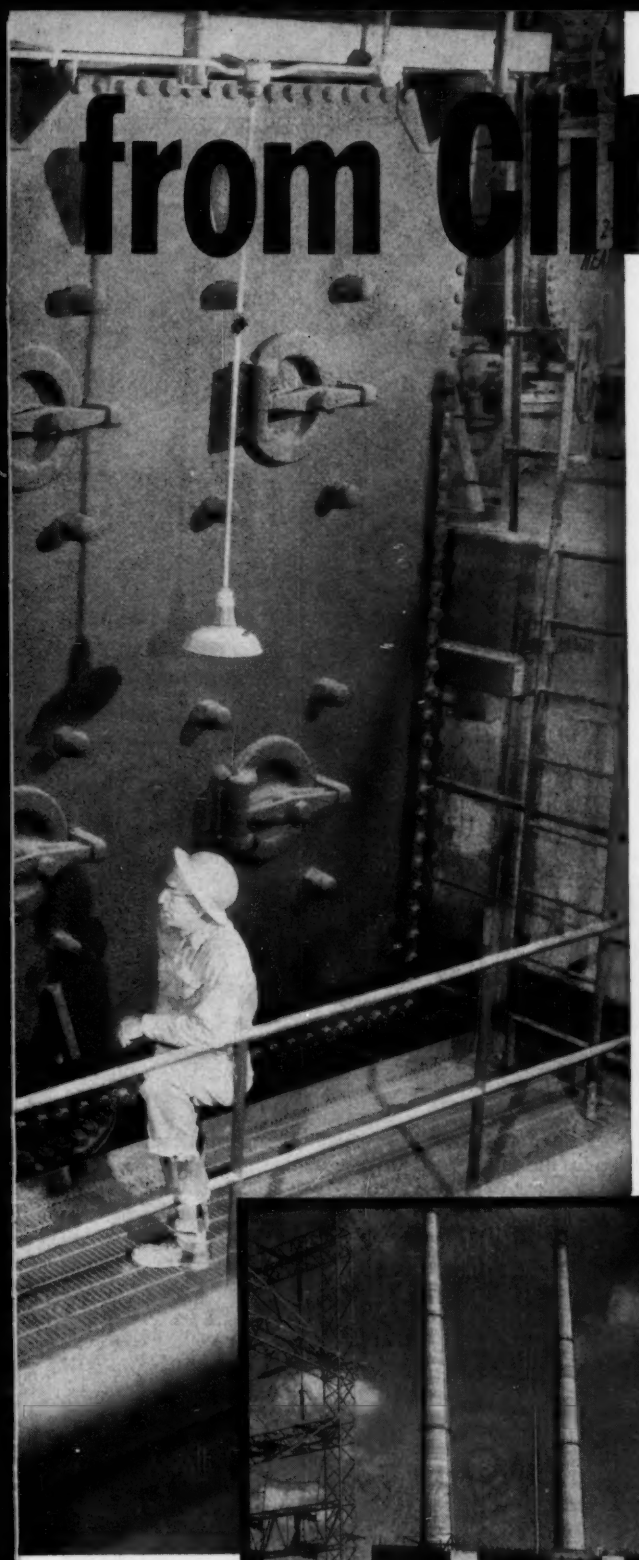
A Size and Type for Any Need

Round

Oval

 Rectangular

ALLIS-



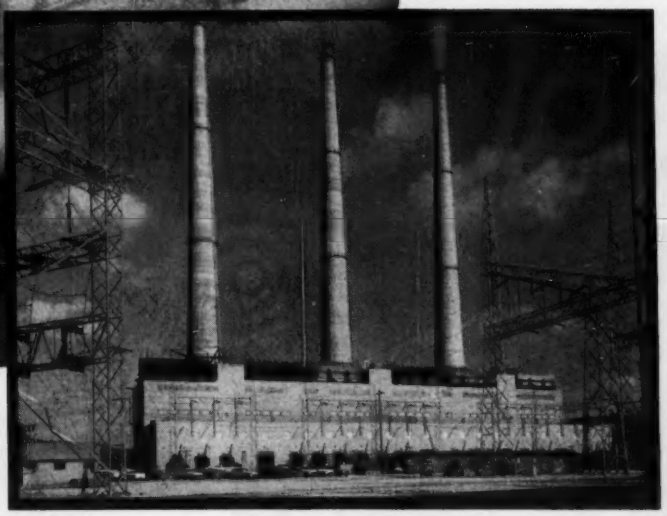
from Clifty Creek

World's Largest Investor Owned Generating Plant Completes Installation of Sixth Allis-Chalmers Condenser

More power for the Atomic Energy Commission! Giant Clifty Creek Plant, with a capacity of 1,290,000 kilowatts — more than that of Hoover Dam — is the largest power plant ever built by private enterprise.

Just completed, Clifty Creek is one of two major steam plants built by the Ohio Valley Electric Corporation to supply the electric power requirements of AEC's tremendous new Portsmouth (Ohio) atomic plant. Clifty is located on the Ohio River at Madison, Indiana. OVEC is sponsored by 15 private utility companies of the Ohio Valley region.

Six 100,000-sq-ft, single-pass Allis-Chalmers surface condensers serve the Clifty Creek Plant's six 215,000-kw steam turbine-generator units.



Condensers of Unusual Design

Multi-steam-path design is a feature of each condenser. This unique A-C design makes *all* tubes completely effective from one end to the other by directing steam to even the most remote sections of the condenser.

The result is high vacuum, high condensate temperature and good deaeration . . . in other words, high operating efficiency.

Get Information

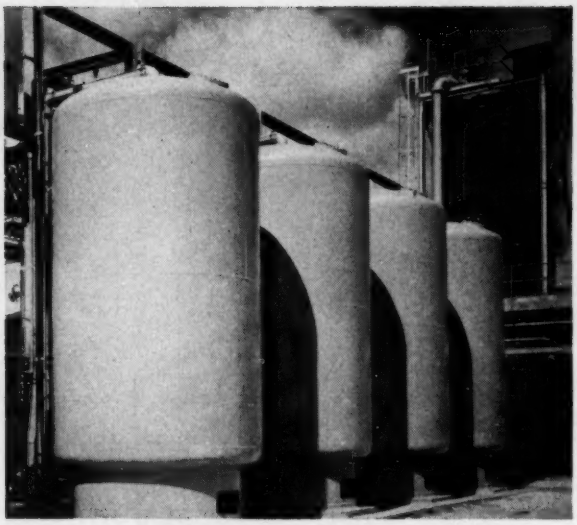
For information about Allis-Chalmers multi-steam-path design, contact your nearest A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-5038

LIVE BETTER ELECTRICALLY

CHALMERS

A-C ALLIS-CHALMERS

ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

How Permutit® Solves a Water Problem

U. S. industry is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.

• **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:

• **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.

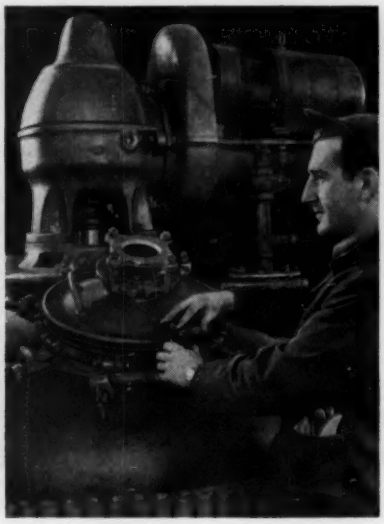
• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and performance guarantees.

• **Manufacturing** — After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

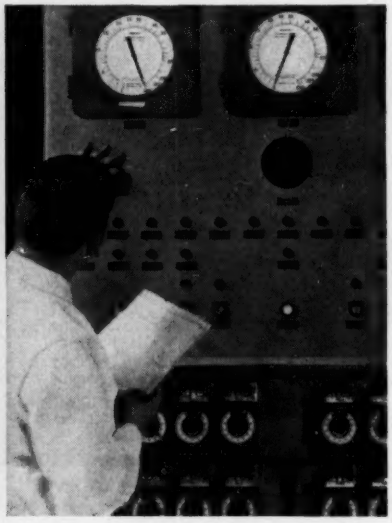
• **Test runs** — Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, Dept. P-5, 330 West 42nd St., New York 36, N. Y.

WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!



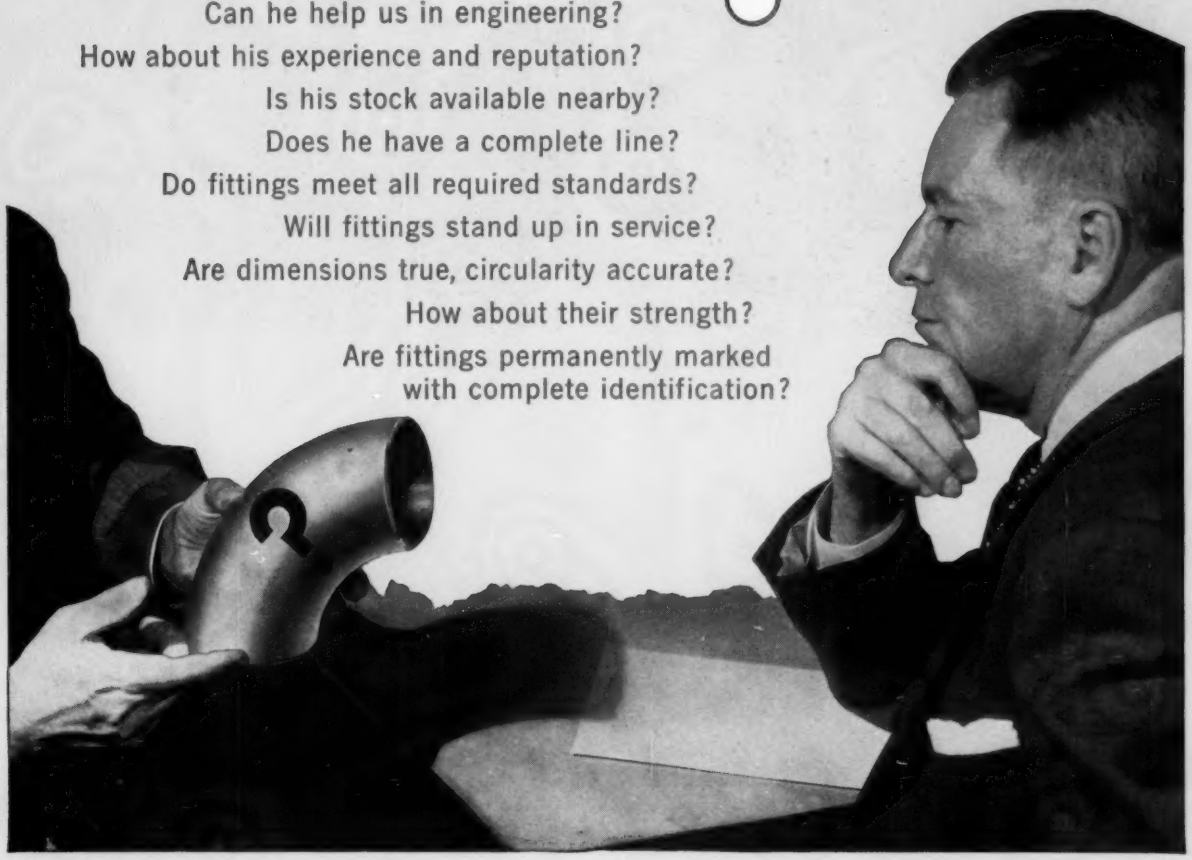
ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.

why run a risk with Question-Mark fittings

Is the manufacturer a piping specialist?
Can he help us in engineering?
How about his experience and reputation?
Is his stock available nearby?
Does he have a complete line?
Do fittings meet all required standards?
Will fittings stand up in service?
Are dimensions true, circularity accurate?
How about their strength?
Are fittings permanently marked with complete identification?



No unanswered question...no risk
when you buy known fittings

YOU SAVE purchasing time and avoid trouble later on when you buy TUBE-TURN® Welding Fittings and Flanges. Made in U.S.A. by the leader in the field, these products give you top quality and uniformity, backed by unmatched engineering service and nearby complete-line distributor facilities. They meet *all* American Standard and Safety Code requirements. Each product is permanently identified by the "TUBE-TURN" trademark with complete size and material designation. You can't get a better bargain in welding fittings and flanges than from your trusted Tube Turns' Distributor!

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Kansas City • Denver
Los Angeles • San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

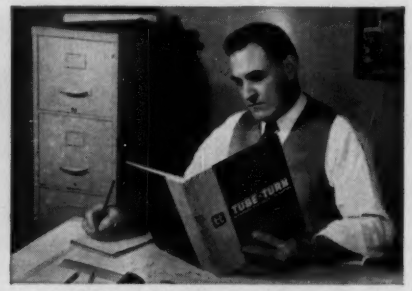
®"TUBE-TURN" and "⌘" Reg. U.S. Pat. Off.

POSITIVE IDENTIFICATION

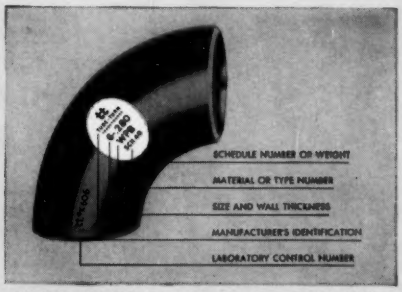
THE WELDER KNOWS he's getting the exact fitting specified on the blueprint because the fitting is clearly marked with all designations.

Complete...Permanent Identification!

THE STOREROOM WORKER KNOWS he is selecting the right fitting when it's marked "TUBE-TURN". The fitting bears complete information called for on the requisition.



THE DESIGNER KNOWS that his specifications will be carried out precisely where his drawings call for "TUBE-TURN products". At every stage . . . from purchasing to pipe installation, people KNOW what they're getting and using.



CLEARLY MARKED. TUBE-TURN* Welding Fittings are completely identified as to dimensional and metallurgical facts. Here is your assurance that you have the RIGHT fitting, and that it has passed Tube Turns' rigid inspection and quality control.

This is just *one* reason why you should specify the leading brand of fittings and buy from your trusted Tube Turns' Distributor.

TUBE-TURN Welding Fittings and Flanges are made in U. S. A.
They meet *all* U. S. piping code specifications.

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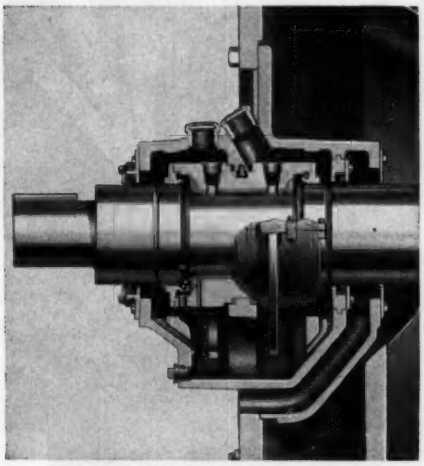
tt TUBE-TURN

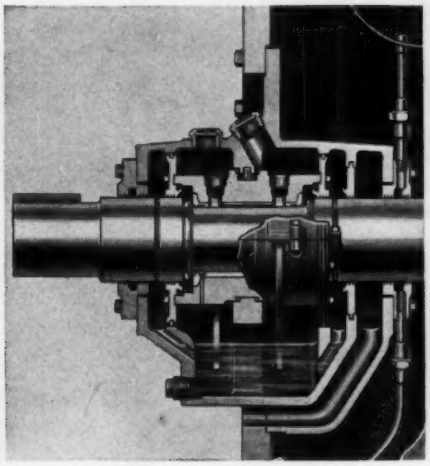
*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

NEW Bearing Design Means Better Motor Performance

Allis-Chalmers capsule-type sleeve bearings now perfected for complete motor line



Standard capsule-type sleeve bearing



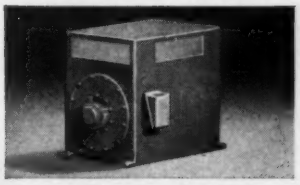
High speed capsule-type sleeve bearing

A new feature—an improved capsule-type bearing design—has been added to the Allis-Chalmers complete line of large end-shield bearing motors. This new bearing will give you better motor service, simplified maintenance and longer motor life through features like:

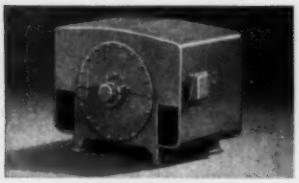
- Dust-tight, leakproof enclosure protects bearing from dirt, dust or abrasive materials.
- Venting system prevents oil leakage — keeps oil and vapor from getting into motor enclosure.
- Dual oil-rings insure bearing surface lubrication — either ring can adequately lubricate bearing.
- Split end-shield gives easy accessibility to winding and air gap — without disturbing capsule or bearing alignment.

Drip-proof or splash-proof cage motor

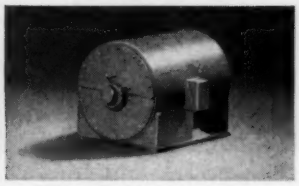
Synchronous or wound-rotor motor



High speed cage motor

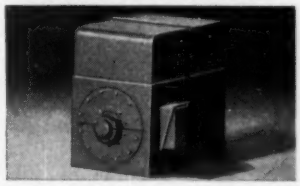


Weather-protected motor



Totally-enclosed fan-cooled motor

Totally-enclosed forced-ventilated motor



Water-cooled or inert-gas-filled motor

Capsule-type bearings are standard on these Allis-Chalmers motors.

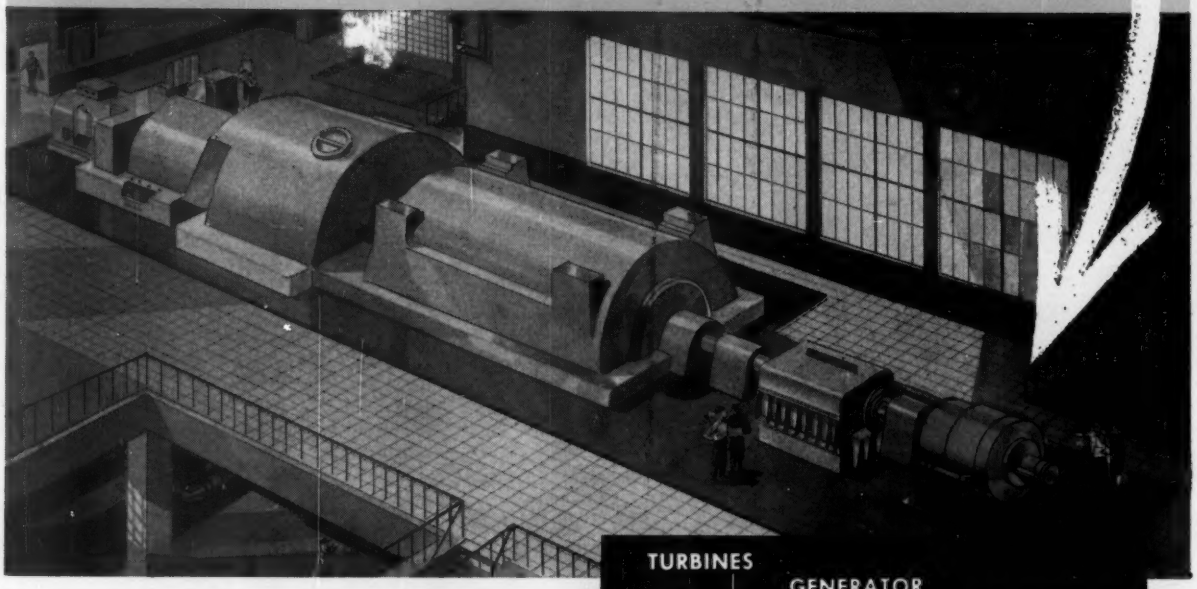
You get MORE from Allis-Chalmers motors

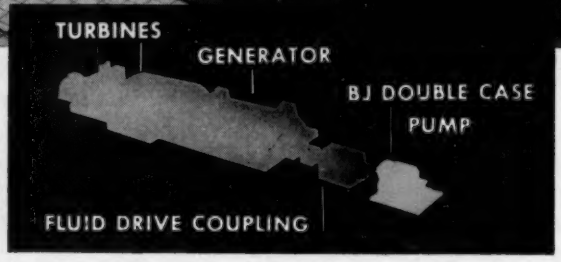
More design and construction features — more application help. For complete information, contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5032

Byron Jackson makes history with World's Largest Boiler Feed Pump!





Byron Jackson is building the world's largest double case, high pressure boiler feed pump. According to BJ engineers, this pump will be at least twice as large as any boiler feed pump now in existence in the world. This huge unit—rated at 12,000 hp—will deliver 6,330 gallons per minute of feed water against a total dynamic head of 6,400 feet, or approximately 2,700 pounds per square inch at an operating speed of 3,510 rpm. It is being built for the Consolidated Edison Co. of New York, Inc.

A modification of the Byron Jackson-originated double case barrel type feed pump, the unit will consist of a cylindrical outer barrel and cover enclosing a horizontally-split inner volute case. The double volute design, together with back-to-back mounting of the impellers, provides for quick, uniform heating and reduces axial and radial thrust to a minimum.

UNIQUE DRIVE SYSTEM

For this BJ super pump, power company engineers are employing an altogether new concept of drive, the main generator steam turbine. Power is transmitted through an American Blower Corporation fluid drive coupling for variable speed operation to meet all load conditions.

To provide trouble-free operation, BJ engineers will incorporate packless type stuffingboxes with controlled leakage as well as a rotating element of rigid construction, limiting shaft sag to about one-third of the wear-surface clearances. Amazing as it may sound, this pump could be run dry.

ANOTHER BYRON JACKSON "FIRST"

This pump represents one more pioneering step undertaken by Byron Jackson in its long history of designing rugged, trouble-free pumps for any service.

BJ

Byron Jackson

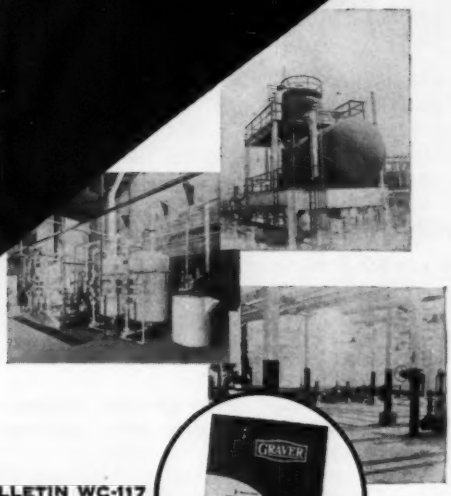
Division of Borg-Warner Corporation
P. O. Box 2017A, Terminal Annex
Los Angeles 54, California

Water Treatment Specialists

FOR FIFTY YEARS

GRAVER®

Hot Process Softeners • Deaerating Heaters
Cold Process Softeners and Clarifiers
Demineralizers • Zeolite Softeners
Hot Zeolite Softeners • Filters
Continuous Boiler Blowdown Equipment
Dealkalizers

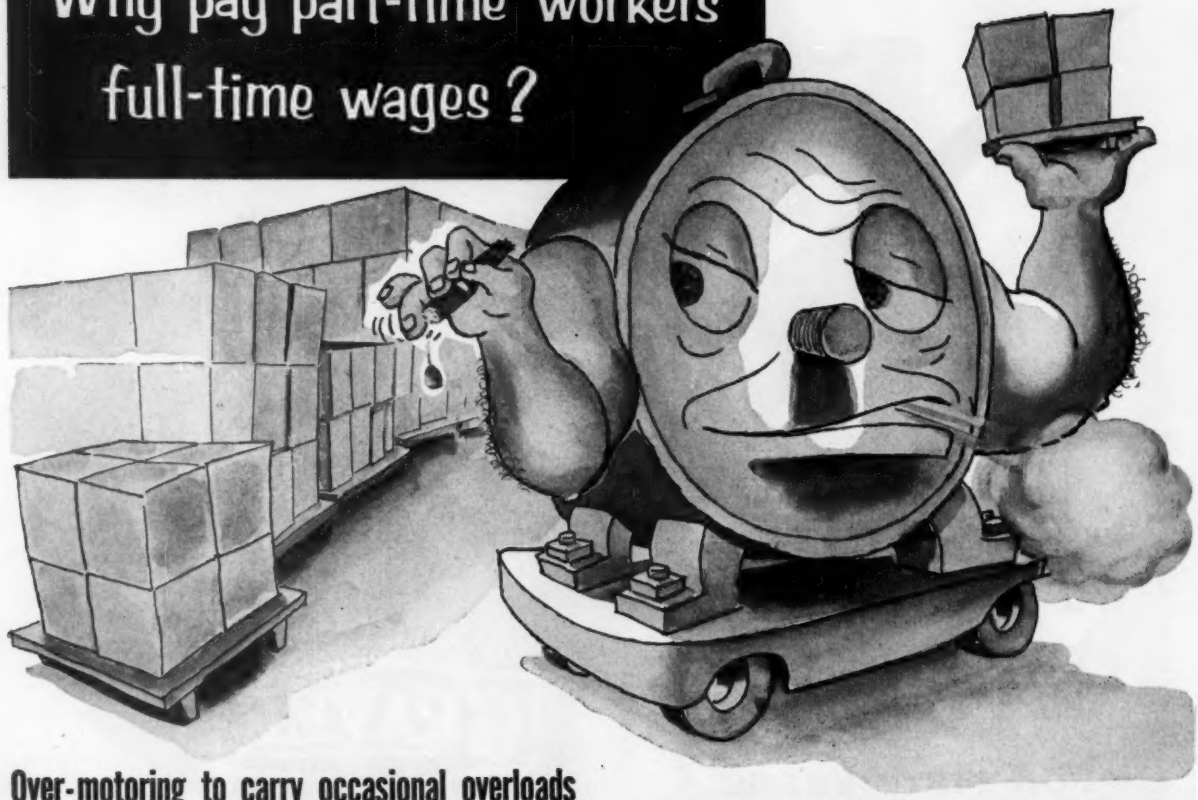


WRITE FOR GENERAL BULLETIN WC-117 AND SPECIFIC BULLETINS

Industrial Department I-211

GRAVER® **GRAVER WATER CONDITIONING CO.**
Division of Graver Tank & Mfg. Co., Inc.
216 West 14th Street, New York 11, N. Y.

Why pay part-time workers full-time wages?



Over-motoring to carry occasional overloads is outmoded by silicone insulation!

Once it was standard practice to install motors rated to meet peak loads. But today you can save money by using *silicone insulated* motors to match the *average load*. Their built-in service factor (ranging up to 50%) will carry most intermittent overloads!

Motors Insulated with Dow Corning Silicones Mean . . .

Lower capital investment and installation costs
For every dollar sunk in unused motor capacity you also waste another $3 in installation and distribution service costs.

More continuous production
Motors insulated with Dow Corning silicones give you maximum resistance to heat, moisture and corrosive atmospheres.

10 years of proof in service!

Automatic Transportation Company has used silicone insulation on all of the lift truck motors they have manufactured since 1946 . . . "because silicone insulation contributes to longer life and can take harder abuse than other insulating materials." In daily service these motors are constantly lifting capacity loads . . . and every time a truck climbs a 2% grade, the torque on its motor is doubled. Yet, according to Automatic Transportation Engineers, in the ten years since adopting silicone insulation . . . "we have never, to our knowledge, lost a motor due to insulation failure."

Use this coupon today!

Dow Corning Corporation, Dept. 6905, Midland, Mich.
Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____
COMPANY _____
STREET _____
CITY _____ ZONE ____ STATE _____

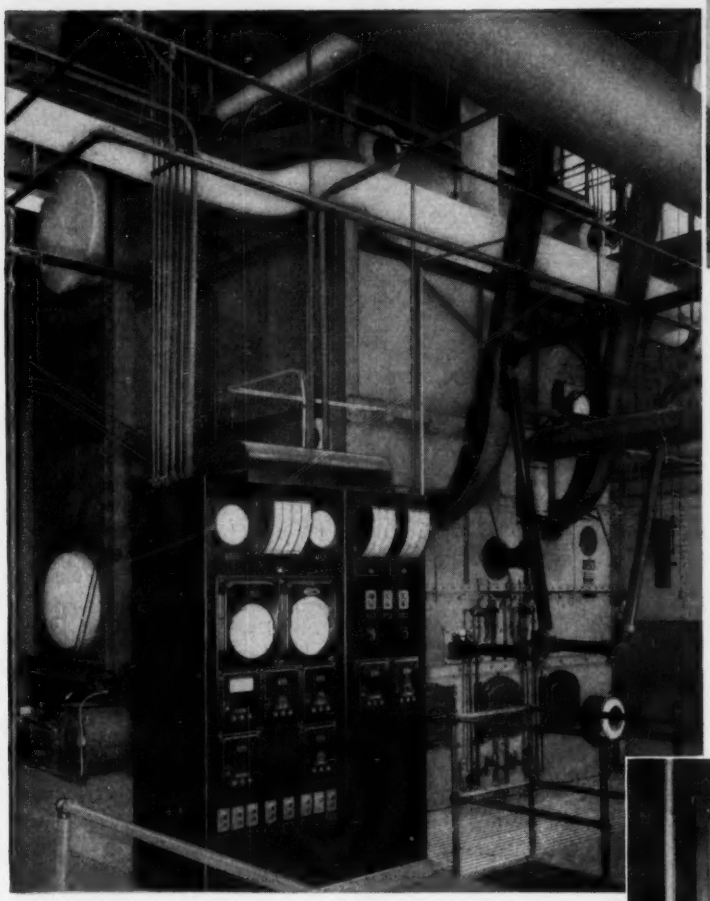
DOW CORNING SILICONES

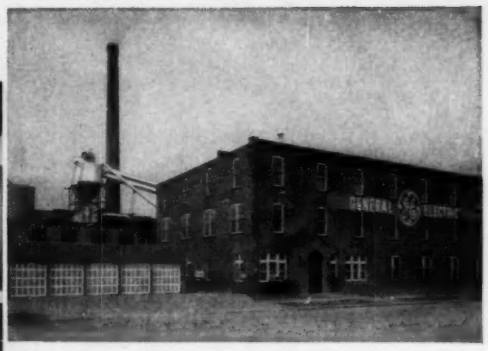
DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
LOS ANGELES • NEW YORK • WASHINGTON, D.C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

KEELER TYPE M-K STEAM GENERATOR SERVES G-E CABINET PLANT



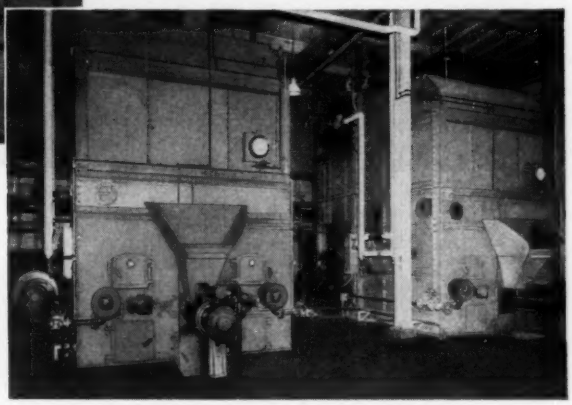


General Electric Company
Illinois Cabinet Works
Rockford, Illinois

KEELER

TYPE M-K

All purpose cross drum water tube type steam generators provide high efficiency with any method of firing—for coal, oil, gas or waste fuel operation (or combinations), with ready convertibility.



In modernizing the power plant of its Illinois Cabinet Works, the General Electric Company selected the Keeler Type M-K Steam Generator pictured above to supply low cost steam for its process and heat requirements.

The unit has a rated capacity of 35,000-lbs. of steam per hour and a 200 psi design pressure. This is a coal fired operation, of the automatic over-fired, spreader type with provision for conversion. The complete Keeler installation includes all burning equipment, controls. safety devices and accessories.

Keeler Type M-K Steam Generators provide the efficiency of bent tube construction with fast water circulation. A Keeler modernization of old and proven techniques, they feature a compact design that prevents excessive radiation losses with water cooled, completely steel encased and insulated furnace walls and roof.

The Type M-K is made in capacities from 12,000 to 150,000-lbs. of steam per hour with a standard design pressure of 160 psi, a maximum design pressure of 500 psi and a total maximum steam temperature of 750° F. These generators can be operated at high ratings and high efficiency with any firing method, for burning coal, oil, gas, waste fuel as well as combinations, and include provision for ready convertibility.

The list of Keeler Type M-K installations reads like "Who's Who of American Business and Industry" . . . including aircraft, automotive and chemical plants, universities, hospitals and central heating plants. The two unit photo immediately above shows a recent installation in a large mid-western college.

Write or phone for complete information . . . there's a Keeler representative at your service in your locality.

The Seal of Quality in Water Tube Boilers

Write For Bulletins

No. MK-1: Type MK Boilers
No. DK-1: Type DK Package Boilers
No. F-14: Type CP Package Boilers
No. M-2A: Type CPM Package Boilers

KEELER WATER TUBE *Boilers*

— ESTABLISHED 1864 —

E. KEELER CO.

200-300 West St. • WILLIAMSPORT, PA.

— OFFICES IN PRINCIPAL CITIES —

The true cost of an expansion joint is not the figure on the manufacturer's price tag. Many factors enter into any such cost determination. For example, an expansion joint that fails just when it shouldn't could wreck a plant and cost a small fortune. And, assuming equal first-cost of any two competitive manufacturers' designs, one that stands up twice as long as the other . . . costs only half as much on a unit-time basis. So, one really shouldn't count on "price" as a measure of value.

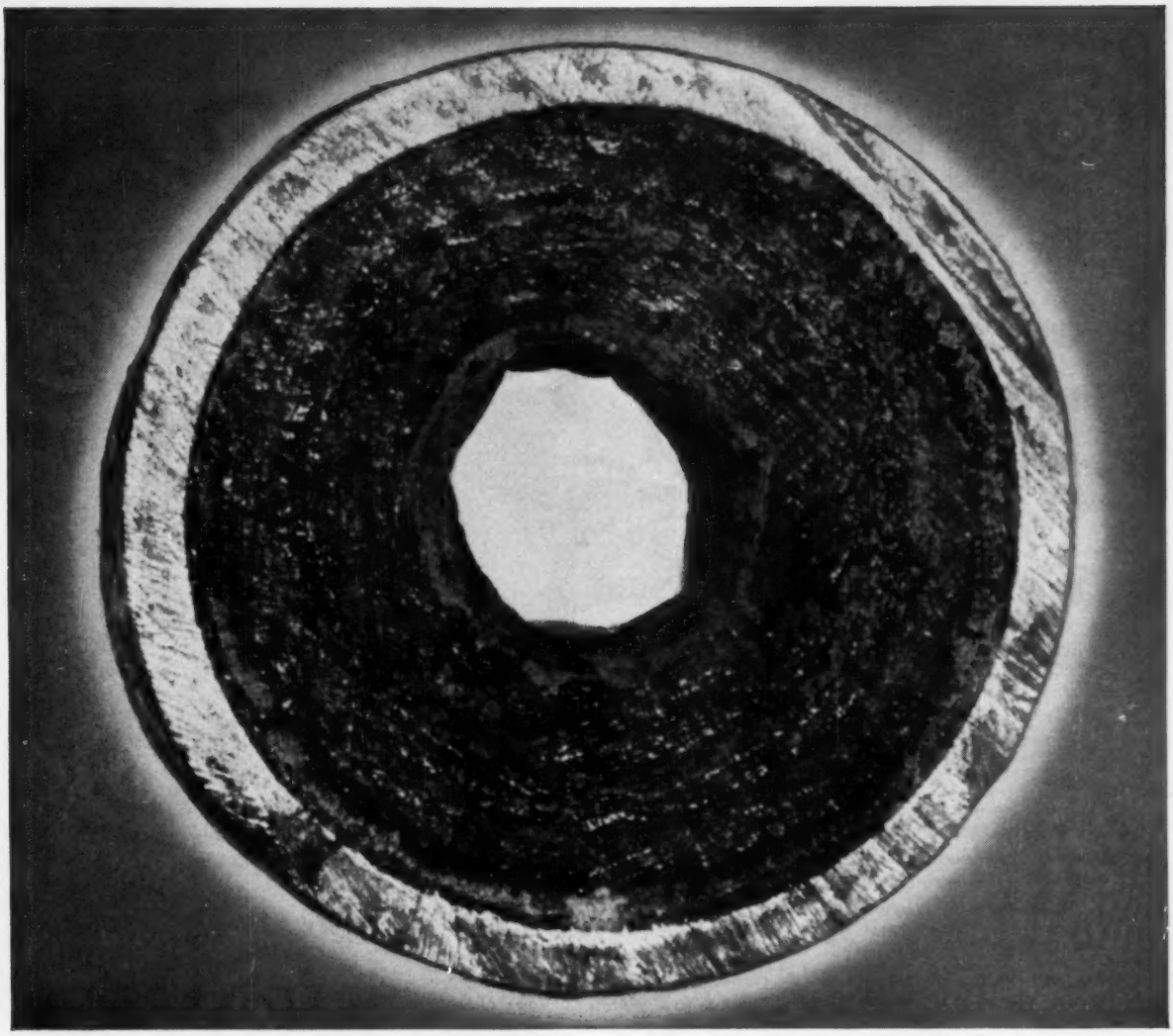
But here is one thing you can count on. Every single expansion joint in the Zallea line is designed and built to assure maximum reliability —and top value for your dollar. This is no empty boast, but a fact that can be confirmed for you by figures.

So, whenever you have problems—or needs—relating to expansion joints, don't fail to get in touch with Zallea. Write today for Bulletin 351, containing condensed descriptions of the many types. There is a Zallea joint for every requirement.

Zallea *expansion joints*

ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints



END OF THE LINE

SCALE—layer upon layer of it—has reduced the inside diameter of this pipe to practically nothing. It's a common occurrence in some power plants, and the results are costly. The line must be taken out of service. That means production loss and expensive maintenance or replacement.

Scale, sludge, carry-over, and return-line corrosion are but a few of the problems that must be overcome to assure efficiency in boiler plant operation. In Dearborn's complete line of water conditioning products, there is the correct treatment to eliminate every water trouble—the properly balanced treatment to reduce unnecessary maintenance, avoid shutdowns, and protect valuable equipment.

Since 1887, Dearborn products have provided trouble-free water to users of steam in all types of industry. That's why, today, power engineers in leading industrial plants throughout the nation look to Dearborn for consultation and assistance in solving their water treating problems.

Dearborn®

...a leader in water conditioning and corrosion control

MAIL THE COUPON

Dearborn Chemical Company, Dept. PO
Merchandise Mart Plaza, Chicago 54, Ill.
Please send me complete information on Dearborn Water Conditioning.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*....*State*.....

NEW

MICROAMMETER
MILLIVOLTMETER
RECORDER
PERFORMS 6
ESSENTIAL FUNCTIONS

★ **Measures low-level dc signals with calibration accuracy within 0.5%, and sensitivity within 0.2% of span.**

★ **Records on 3" continuous strip chart or IBM-type card chart, with linear coordinates.**

★ **Positions recording pen with force many thousand times greater than usual direct-deflection electrical movements.**

★ **Operates on force-balance principle compensating for ambient conditions, changes in power supply and components.**

★ **Gives high-speed recording — up to 0.05 seconds for 63% of fullscale changes.**

★ **Provides span and zero adjustments for ease of calibration and zero suppression in the field, without special equipment.**

The new 'American-Microsen' Series 130 Recorder is a highly sensitive microammeter or millivoltmeter that gives positive, accurate electrical measurement and rugged, maintenance-free service. Yet the unit costs less than other recorders for the same purpose.

Heart of the Series 130 Recorder is the "Microsen" balance that converts low-level dc input signals into powerful output current to drive the recording pen. Pen position is fed back to the input. Consequently, the recording unit is force-balanced in precise relationship with the input signal. Power is ample to operate alarm contacts, which are available.

SPECIFICATIONS

POWER SUPPLY: 115 volts, 60 cycles. **POWER REQUIREMENT:** 9 watts

INPUT RANGES: Voltage — 0-20 millivolts to 0-100 volts dc. **Current** — 0-200 microamperes to 0-100 milliamperes dc. **Input Sensitivity** — 6700 ohms per volt.

ACCURACY: ± 0.5% of span. **SENSITIVITY:** ± 0.2% of span. **REPEATABILITY:** ± 0.25% of span.

EFFECT OF SUPPLY VOLTAGE: Less than 0.5% error 90-130 volts.

EFFECT OF AMBIENT TEMPERATURE: Less than 0.5% error 50° to 100° F., and less than 1% to 130° F.

RESPONSE TIME: Fast Speed — 0.2 seconds standard for 63% of fullscale input change; up to 0.05 seconds for 63% on special order. **Slow Speed** — approximately 4 times fast speed setting.

SHOCK RESISTANCE: Withstands shock up to 30 times gravity.

CHART SPEEDS: Strip Chart — 1" per hr., standard; 3" or 6" per hr. available. **Card Chart** — 1 rotation per day, standard.

SPAN ADJUSTMENT: ± 10% of span. **ZERO ADJUSTMENT:** ± 100% of span.

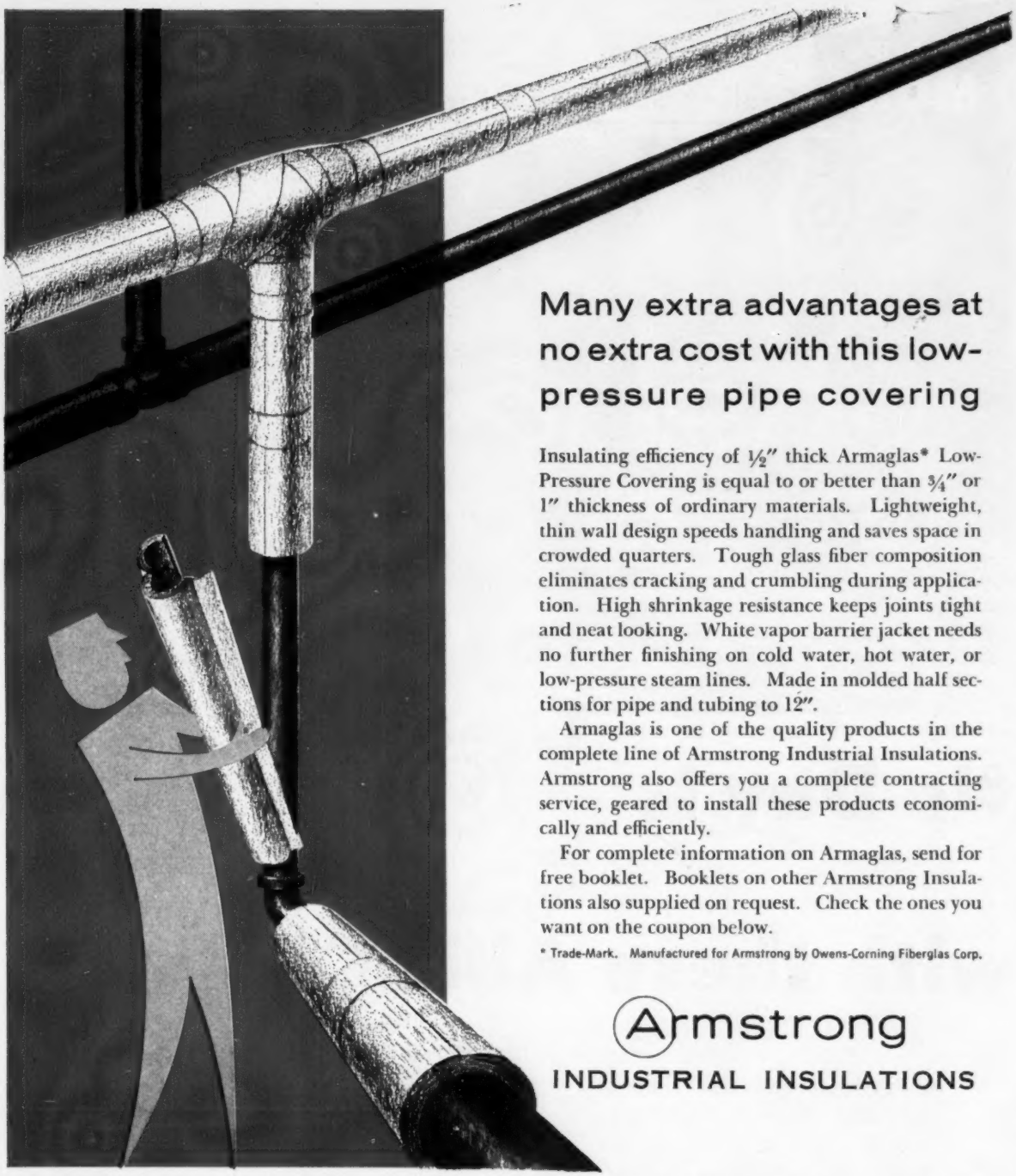
PRICE: $250.00 consumer net for standard models.

Write for Bulletin MG10

MANNING, MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION, STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC TRANSMITTERS, INDICATORS, RECORDERS, CONTROLLERS, ELECTRO-PNEUMATIC VALVE POSITIONERS AND ELECTRO-HYDRAULIC CONTROL VALVE OPERATORS.



Many extra advantages at no extra cost with this low-pressure pipe covering

Insulating efficiency of ½" thick Armaglas* Low-Pressure Covering is equal to or better than ¾" or 1" thickness of ordinary materials. Lightweight, thin wall design speeds handling and saves space in crowded quarters. Tough glass fiber composition eliminates cracking and crumbling during application. High shrinkage resistance keeps joints tight and neat looking. White vapor barrier jacket needs no further finishing on cold water, hot water, or low-pressure steam lines. Made in molded half sections for pipe and tubing to 12".

Armaglas is one of the quality products in the complete line of Armstrong Industrial Insulations. Armstrong also offers you a complete contracting service, geared to install these products economically and efficiently.

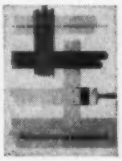
For complete information on Armaglas, send for free booklet. Booklets on other Armstrong Insulations also supplied on request. Check the ones you want on the coupon below.

* Trade-Mark. Manufactured for Armstrong by Owens-Corning Fiberglas Corp.

Armstrong

INDUSTRIAL INSULATIONS

☐ Armstrong Armaglas Insulations for Pipes, Tanks, and Vessels



☐ Armstrong Insulcolor®, Weatherproof Coating in Eight Colors

☐ Armstrong LT Cork Covering, a New Type Cold Line Insulation

☐ Armstrong Armaflex**, a New Flexible Insulation for Piping

**TRADE-MARK

Armstrong Cork Company
2005 Riggs Ave.
Lancaster, Penna.

Please send me the free booklets checked.

Please have an Armstrong representative call. ☐

Name .....

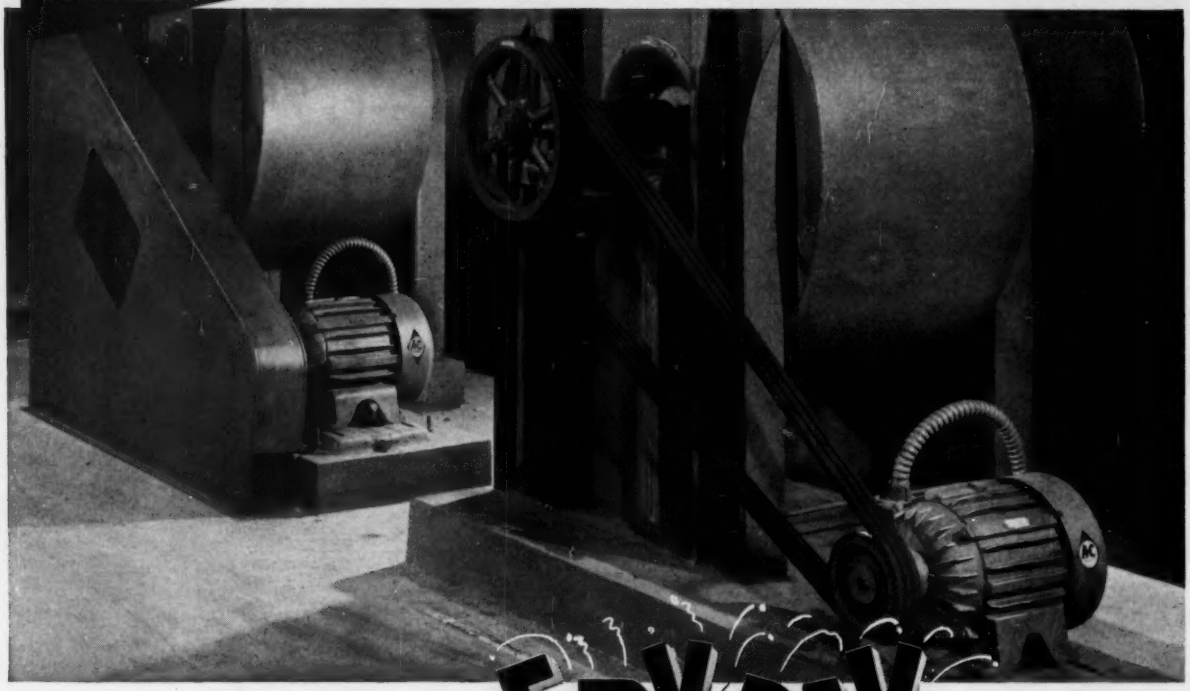
Position .....

Company .....

Address .....

City ..... Zone .... State .....

There's **MORE** Cooling Surface in these deep-ribbed **MOTORS**



No Day is FRYDAY with these Allis-Chalmers MOTORS

● Frying of insulation is impossible under normal conditions with the extra-large cooling surface of Allis-Chalmers rib-type TEFC motors. The result—you expect and get longer motor life.

The engineered partner of A-C motors is Allis-Chalmers control.

Get Complete Information

As a new machinery component or as replacement, specify Allis-Chalmers. Discuss your particular application with your nearby A-C distributor, A-C district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A 4944

This Ell Bolt is the Key to leak control

The patented Ell Bolt construction employed on Vogt floating head heat exchangers is the answer to re-assembly without distortion or leak development.

Cover may be removed by simply loosening the Ell Bolt nuts and disengaging the Ell Bolt heads from the "lock notches." No misplacing of Ell Bolts can result — and tightening is easy and positive — absolutely leak proof. Send for Bulletin HE-6. Address Dept. 24-XP.

Vogt

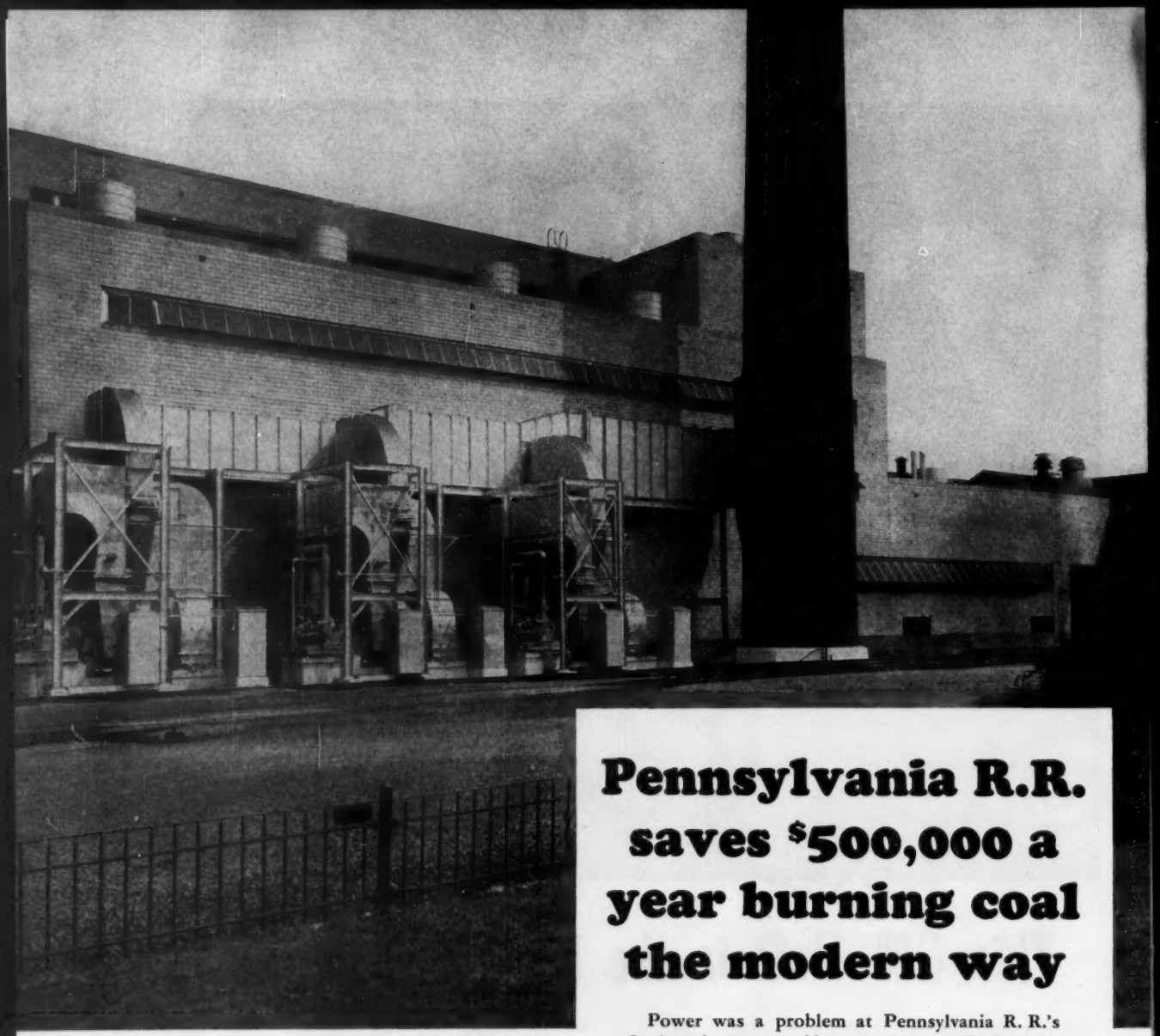
HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1, KY.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati, San Francisco

OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making and Refrigerating Equipment.

HEAT TRANSFER EQUIPMENT



Pennsylvania R.R. saves $500,000 a year burning coal the modern way

Power was a problem at Pennsylvania R. R.'s Juniata shops, part of its great Altoona Works. Low steam pressure was creating costly productior delays; electric power failures meant additional delays; obsolete fueling methods resulted in troublesome flyash emission and other problems.

So Pennsy engineers consulted with Gibbs & Hill, Inc.—designers and constructors for the project—and modernized the power plant. Today three 60,000-lb.-per-hr. 600 psi coal-fired boilers supply steam to the shop area at 150 psi after it has driven two 1,500-kw turbine-generators. Between an adequate steam supply and reliable by-product electrical services, production delays have been eliminated. Air pollution is a thing of the past. Modernization of fuel handling has cut manpower costs. And today efficient operation plus lower fuel costs save Pennsylvania Railroad a half million dollars a year!

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

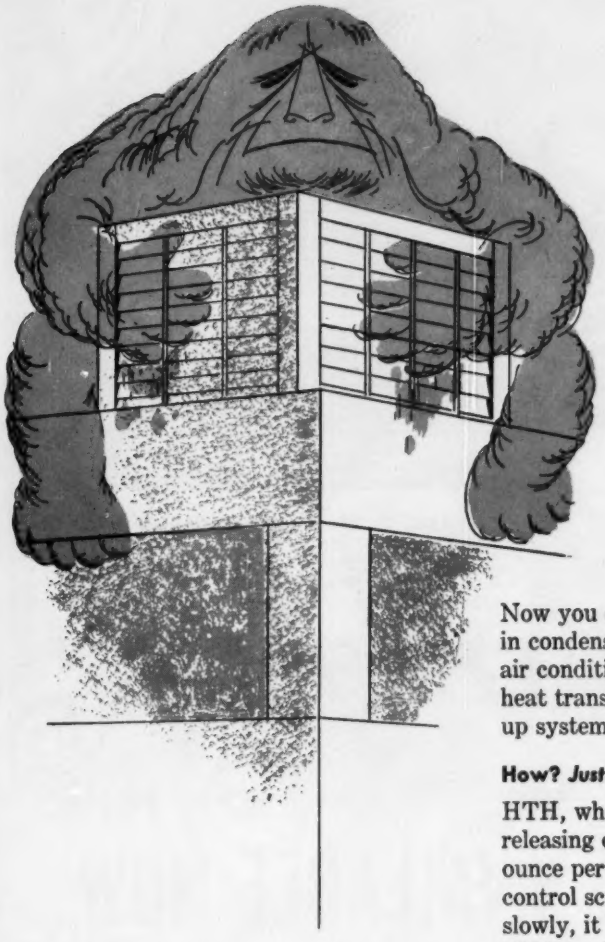
NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D. C.

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.



HTH® rids water systems of green scum

Now you can eliminate troublesome algae growths in condensers, spray towers, cooling ponds, reservoirs, air conditioning equipment . . . algae growths that cause heat transfer loss, produce offensive odors, and clog up systems using recirculated water.

How? ***Just use HTH Granular.***

HTH, when added to water, dissolves quickly, releasing chlorine to provide sure, fast algae kills. One ounce per 1000 gallons of water is generally sufficient to control scum growths. Because these growths form slowly, it is only necessary, in most cases, to add HTH periodically or as a "shot" treatment to obtain the desired results. Frequency of application depends on the nature and condition of the specific water supply.

HTH is dry, stable, easy to use. Containing 70% available chlorine, it is packed in 100-lb. drums and in cases of nine 5-lb. cans. Get all the facts about this safe, effective, economical way to prevent algae growths. *Mail the coupon today.*

MATHIESON

OLIN MATHIESON CHEMICAL CORPORATION
Industrial Chemicals Division
Baltimore 3, Maryland

Please send me full information on the use of HTH to prevent algae growths.

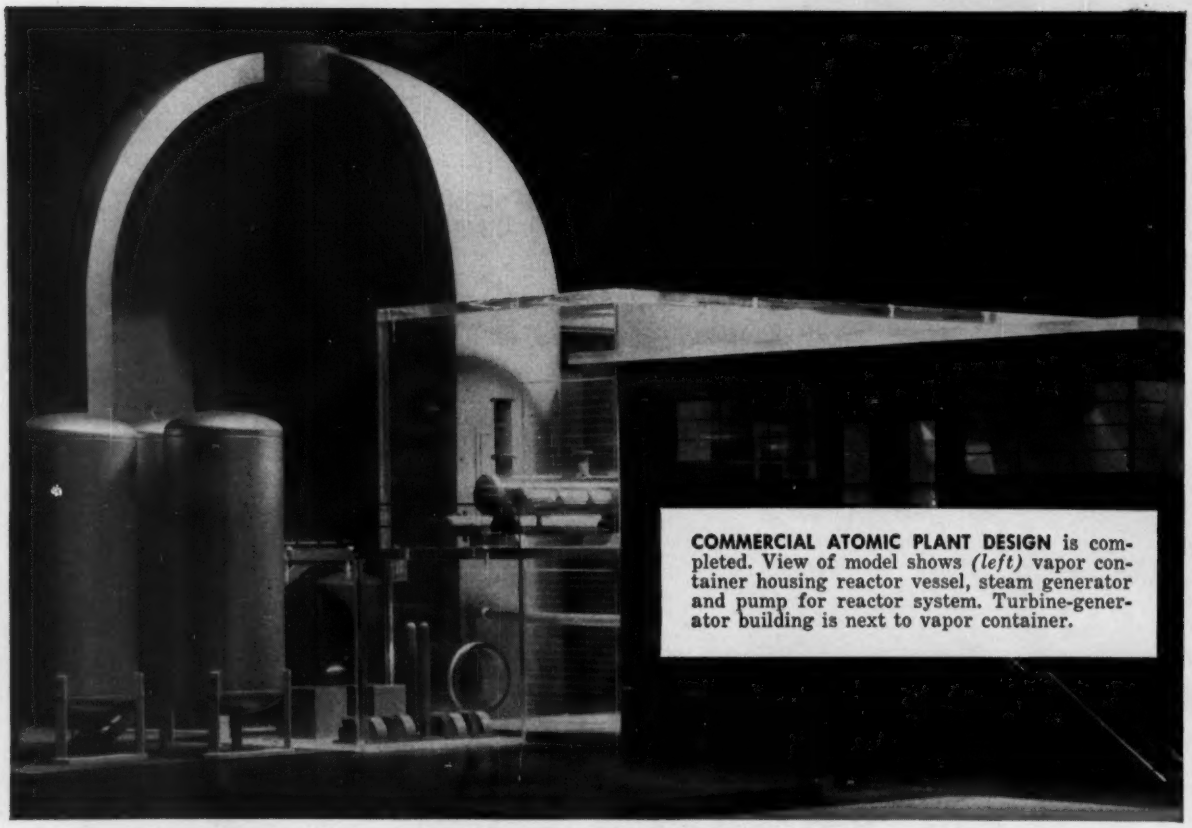
Name_____ Title_____

Company_____

Address_____

_____

3734



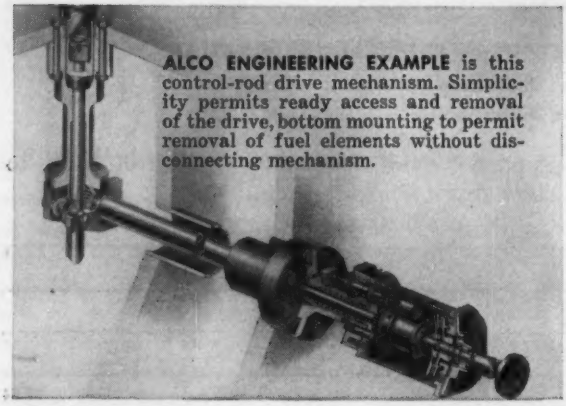
COMMERCIAL ATOMIC PLANT DESIGN is completed. View of model shows *(left)* vapor container housing reactor vessel, steam generator and pump for reactor system. Turbine-generator building is next to vapor container.

ATOMIC POWER IS AVAILABLE NOW

ALCO'S atomic power plants are already designed and engineered; the first is now being built; commercial models can generate stable and economical power

ALCO's atomic power plant is not a dream of the future. It's a reality. The first unit, now being built, will be in operation by early 1957, and similar ALCO atomic plants can be purchased to generate commercial power.

Design and engineering are complete for these pressurized-water atomic plants to about 12,000 kw. This means that their cost is lower than experimental reactors, and delivery time shorter.



ALCO ENGINEERING EXAMPLE is this control-rod drive mechanism. Simplicity permits ready access and removal of the drive, bottom mounting to permit removal of fuel elements without disconnecting mechanism.

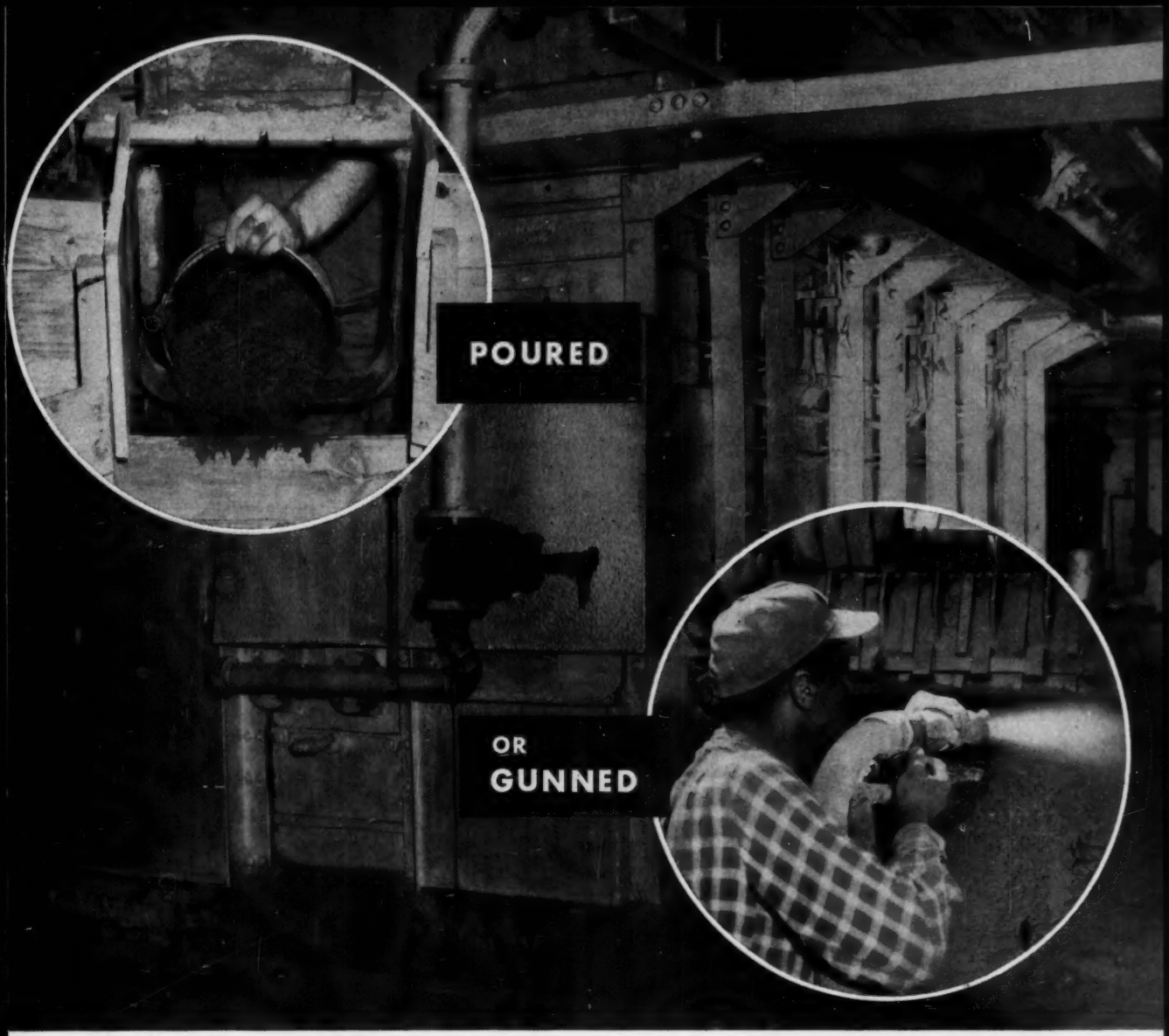
An ALCO atomic power plant can be economical in locations where conventional fuel transportation or power transmission is costly. In these high-cost fuel areas, in cases of high transmission costs, or where no source of hydroelectric power is available, the ALCO atomic plant's operating cost may mean a saving. And the ALCO atomic plant is reliable in operation.

For full information relating to your specific project, contact your nearest ALCO representative or P. O. Box 1065, Schenectady 1, N. Y.

ALCO

ALCO PRODUCTS, INC.

NEW YORK



B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

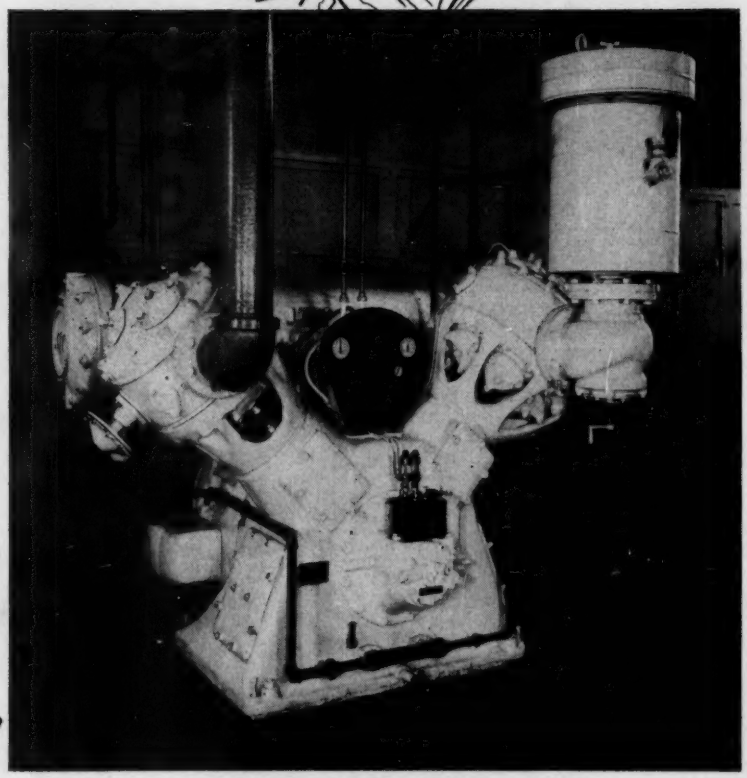
Send for Bulletin R-36 which gives data on B&W's wide line of specialized boiler refractories.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

R548



The Boss asked:

"WHAT'S SPOILING OUR SKILLED MECHANICS?"

. . . so I told him about our JOY WN-112 compressor

"To begin with, the heavy-duty Joy WN-112 supplies dependable industrial air power—up to 125 psi with piston displacement from 368 to 974 CFM. It is a compact two-stage, double-acting, water-cooled compressor—efficient in operation, and vibrationless—reducing wear and tear.

"And this compressor is *easy* to maintain. It has no large, heavy parts that need adjusting. Cylinder liners and cross-head guides are not an integral part of the frame. They can easily be replaced in a short time. Yes, that WN-112 is a breeze to maintain . . . and *that's* what is spoiling our skilled mechanics."

The WN-112 has two separate, protected, force-feed lubricating systems; one servicing the running gear, the other for the cylinders. Even the cross-head face is force-feed lubricated.

Joy "Dual-Cushion" valves have greatly prolonged life because of the variable reaction cushion which eliminates all pounding valve action. Truncated pistons, of strongly reinforced alloy, permit locating of valves on an angle. This insures smooth air flow and efficient head cooling.

All flange-mounted motors for Joy compressors are built to Joy specification. Floor space and foundation requirements, already minimized by the compressor's package design, are 50% less with the flange-mounted motor. The WN-112 is adaptable to other drives if desired.

For complete details, write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for Bulletin 37-16

Consult a Joy Engineer

For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

WBW 15909-37

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

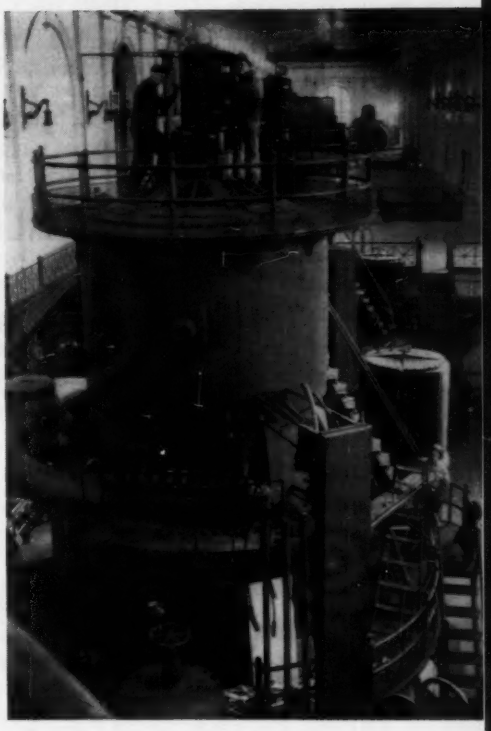
LOUIS N ROWLEY, EDITOR • MAY 1956 • ESTABLISHED 1882 **Power**

Make way for progress

TWENTY-FIVE YEARS AGO, when I was beginning to get my feet wet in the power business, steam temperatures of 750 F were more or less standard for central stations, with a few venturesome designers building for 850 F. Average performance was 1.5 lb of coal per kwhr, with the best plants crowding close to one lb.

In all the years since then, I can't remember a time when we weren't shooting for the next 25- or 50-F rise in temperature and a better heat rate. At times progress seemed painfully slow, as we struggled to solve the problems brought by each step forward.

Such an impression is inevitable when you're close to technical developments, seeing day-to-day changes rather than the long sweep of progress. That's why I got such a wallop out of the photo at the right—and why I'm sure you will too. It gives the long look backward we need once in a while to gain true perspective.



The turbine-generator in the photo is one of the last-three vertical units at Commonwealth Edison's Fisk Station, first all-steam-turbine plant in the U.S. When they were installed back in 1909, these 12,000-kw units ranked among the world's largest. They're later and bigger editions of the 5000-kw machine that launched the station's operations in 1903. That original unit, long retired, is now enshrined at GE's Schenectady plant.

Used in recent years for peak-load and emergency service only, the three 12,000-kw verticals are now being dismantled to make way for a 305,000-kw unit. In this size comparison alone lies dramatic evidence of the gains we've made in the span of a working lifetime.

The old verticals took steam at 200 psi and 513 F. The new machine will operate at 2000 psi and 1050 F. This represents a better than 5:1 performance gain—from about 5 lb coal per kwhr to less than one.

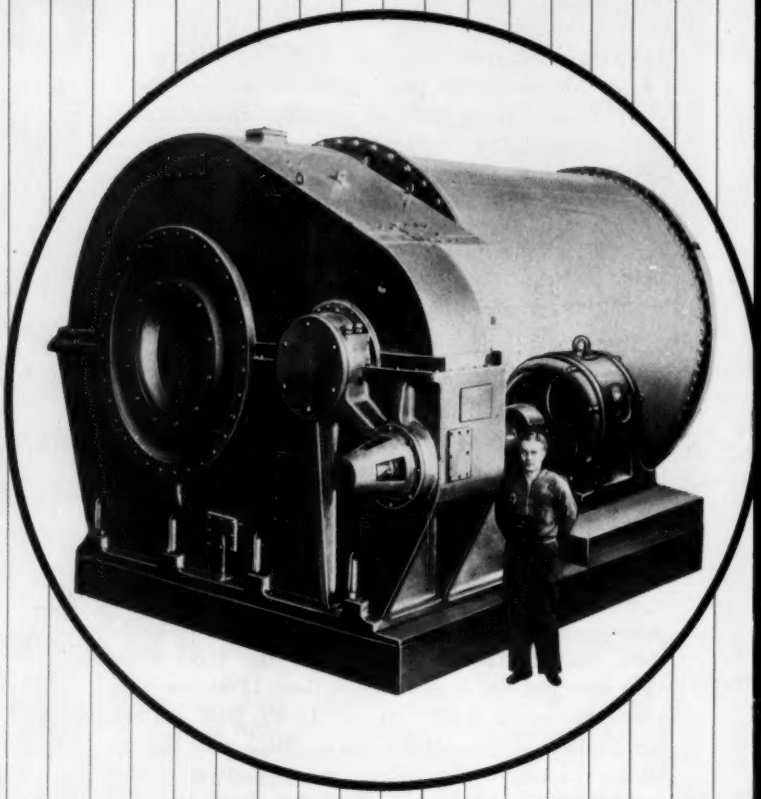
In this long curve of progress we're now working in an inevitably flatter range, where advances are increasingly tough to make. But we continue to make them and so carry on the traditions of one of the great dynamic industries in this dynamic America.

KENNEDY PULVERIZED

• UNBURNT CARBON LOSSES LESS THAN ½ PER CENT

MAXIMUM HEAT FROM EVERY TON OF COAL...

Whether you are modernizing your present plant or building a new one, it will pay you to consult a KVS engineer. He will show you operating data and give you *facts* about plants that are saving as much as $3.00 per ton on coal costs with KVS Pulverized Coal Firing Systems. These tremendous savings are effected through the use of low grade, low cost coal, pulverized to superfineness with instant response to combustion controls. The KVS Pulverized Coal Firing System provides maximum heat from every ton of coal. Consult KVS for "facts that count" in economical steam plant operation.



IT COSTS LESS TO OWN THE BEST!

AIR SWEPT TUBE MILL

Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.

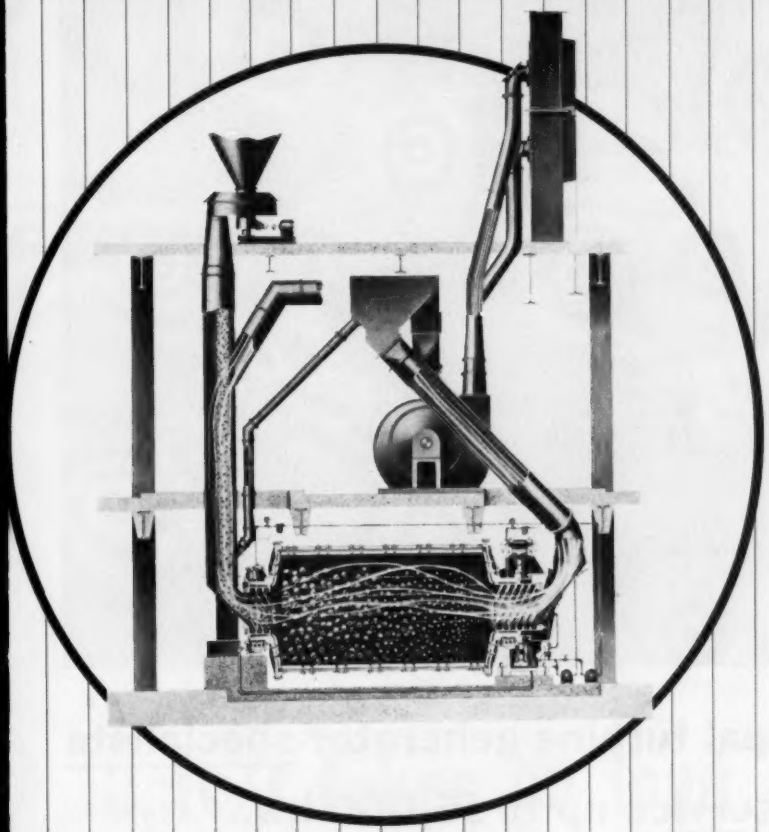
Send for bulletins describing

KENNEDY

MANUFACTURING & ENGINEERING CORPORATION

COAL FIRING SYSTEM

• EFFECTS SAVINGS UP TO $3.00 PER TON ON COAL COSTS



COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

FEATURES OF THE KENNEDY PULVERIZED COAL FIRING SYSTEM...

- FULLY AIR SWEPT
- COAL PULVERIZED TO SUPERFINENESS
- COAL COMPLETELY CARBURETED Ready for combustion
- BIG TRUNNIONS FOR AIR SWEEPING
- BALLS ADDED WITHOUT SHUTTING DOWN
- LOW OPERATING AND MAINTENANCE COSTS
- UNBURNT CARBON LOSSES LESS THAN ½%
- INSTANT RESPONSE TO CONTROLS
- 85% TO 90% THROUGH 200 MESH
- 20% MOISTURE REMOVED WHILE PULVERIZING
- PULVERIZES ANY COAL BITUMINOUS, ANTHRACITE, COKE BREEZE
- TRAMP IRON ACTUALLY AIDS IN PULVERIZING
- RESERVES OF FUEL FOR INSTANT RESPONSE AND STEAM DEMAND

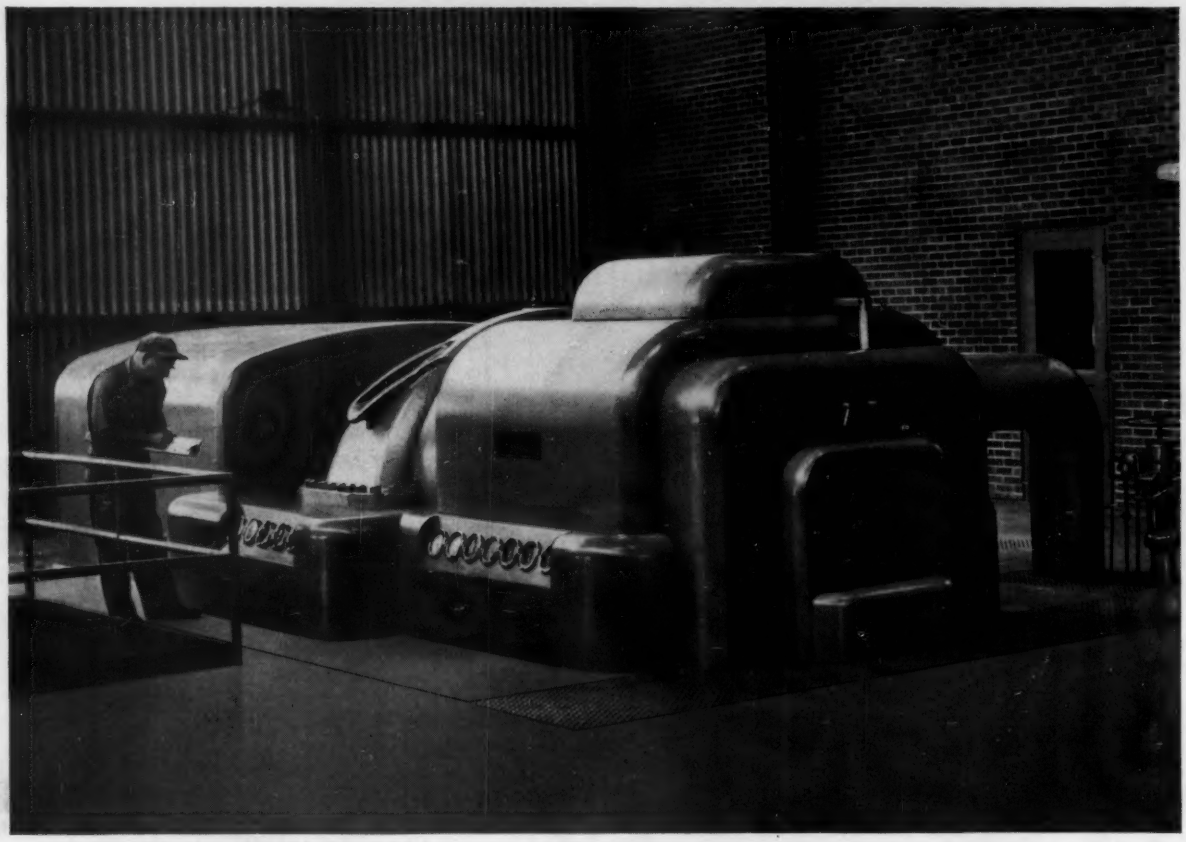
Are you profiting from All these advantages?

KVS machinery and equipment

VAN SAUN

TWO PARK AVENUE, NEW YORK, N. Y. • FACTORY: DANVILLE, PA.

SPECIAL



Industrial and municipal turbine generator specialists give priority service up to 15,000 kw.

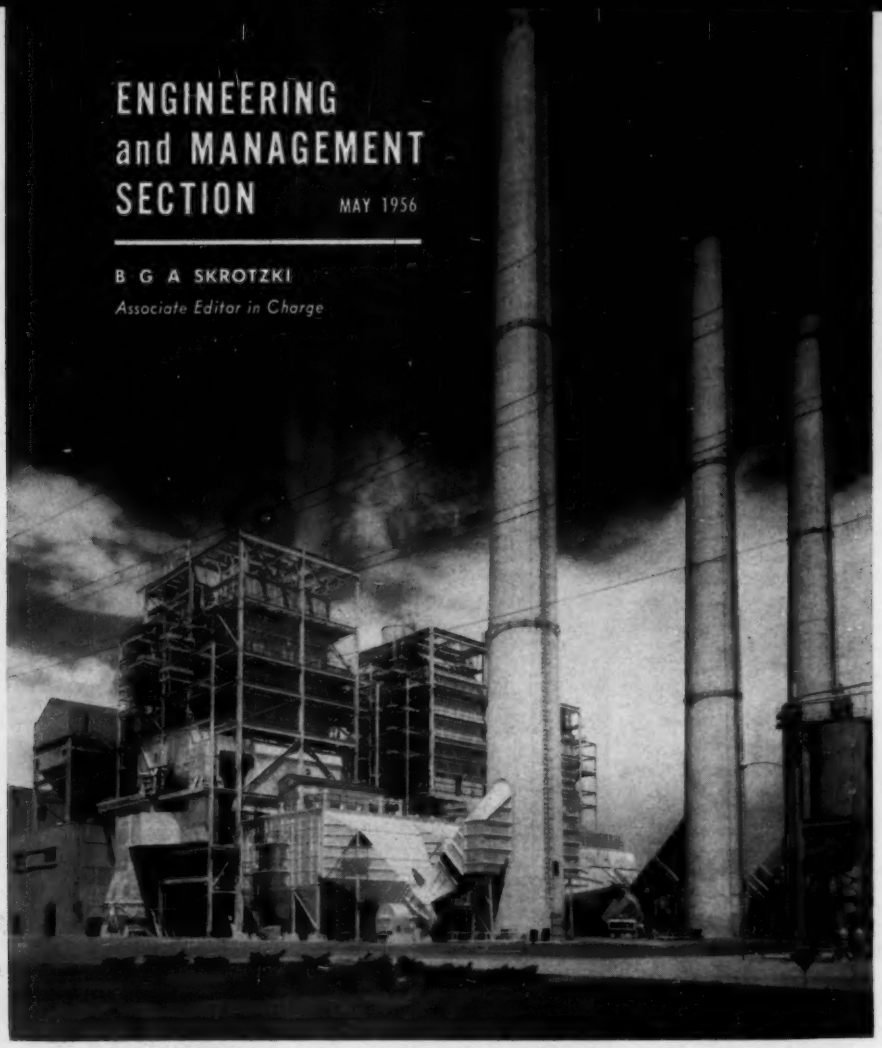
Worthington specialists in designing and manufacturing turbine generators up to 15,000 kw. are changing a lot of established buying ideas. Because they're not involved with building the huge central station turbine generators, Worthington engineers can give A-1 priority to every phase of design and manufacture of industrial and municipal units. They deliver a power package that has been completely tested, and adjustments made, to shorten installation time. They incorporate latest design advances in the turbine and generator, and finish the job with a streamlined heavy steel jacket to blend with the most modern power plant design.

When considering a turbine generator installation up to 15,000 kw., call on specialists in the field. Call your nearest Worthington District Office or write for Bulletin 1960C: Worthington Corporation, A&SP-Turbines, Harrison, N. J.

WORTHINGTON

ENGINEERING
and MANAGEMENT
SECTION MAY 1956

B G A SKROTZKI
Associate Editor in Charge



GADSBY STEAM-ELECTRIC PLANT has outdoor boilers and indoor turbines. Boiler of Unit 3, *at the left,* produces 800,000 lb per hr of 1525-psig 1000-F steam and reheats it to 1000 F

Unit 3 takes on load at Gadsby Plant

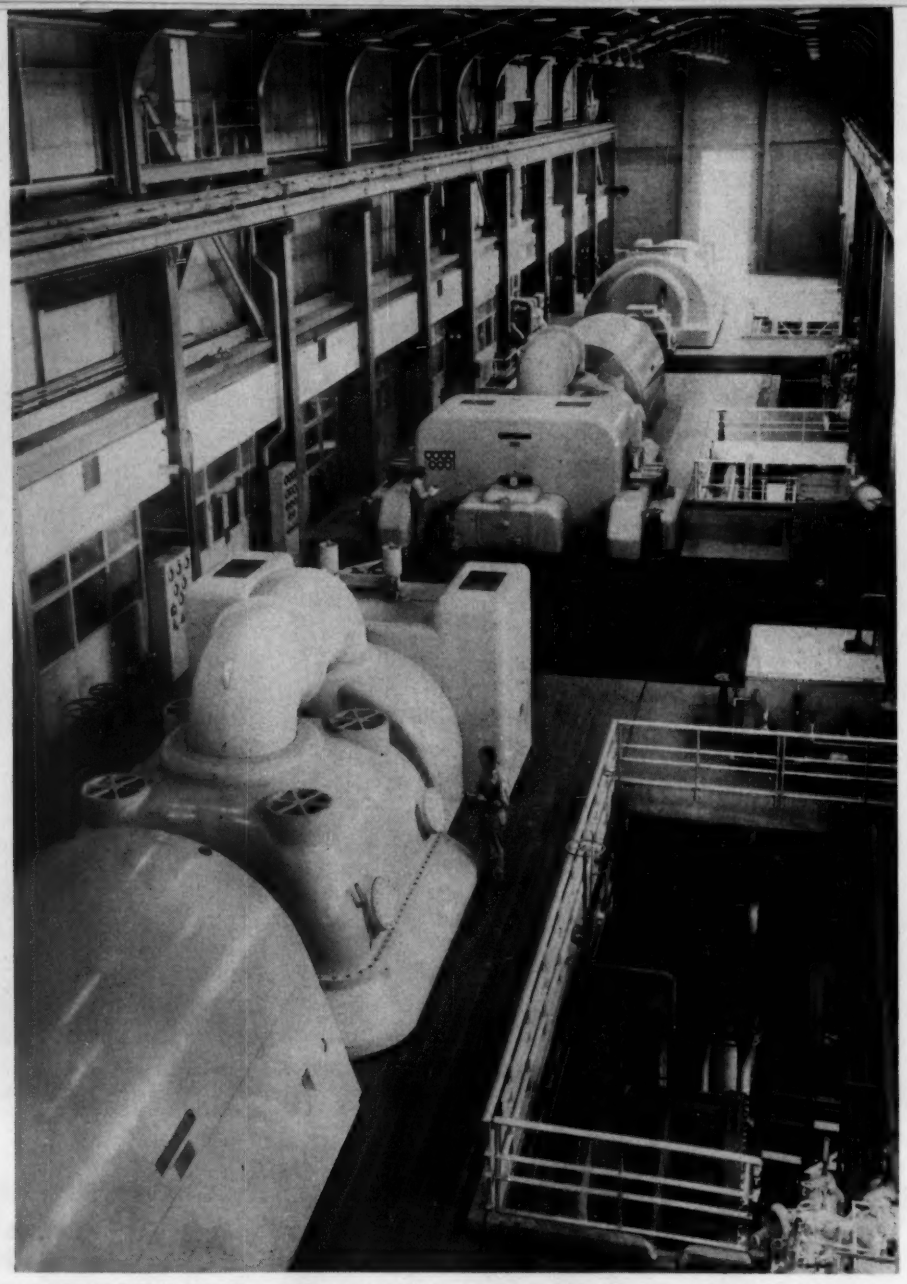
Utah Power & Light Company keeps ahead of demand, which has more than doubled since 1941. Gadsby units burn coal, gas and petroleum pitch, delivered through 4½-mile heated line

By **DOW W RICHARDSON**
Utah Power & Light Company
Salt Lake City, Utah

► GADSBY PLANT stands on the western outskirts of Salt Lake City, Utah. The 246,000-kw plant has three units: No. 1—66,000 kw, No. 2—75,000 kw, and No. 3—105,000 kw. No. 1 started running in Sept 1951, No. 2 in Dec 1952, and No. 3 in April 1955. The last two units use the reheat-regenerative cycles; No. 1 is regenerative only.

Fuel. The outdoor boilers burn the following fuels: No. 1—petroleum pitch to produce 620,000 lb per hr steam; No. 2 pitch to produce 600,000 lb per hr, or coal or gas or both in combination to produce 575,000 lb per hr; No. 3—coal or gas, or combination to produce 800,000-lb-per-hr steam.

During 1955 Gadsby ran with a plant factor of 73%. No. 1 ran at 67%, No. 2 at 71% and No. 3 at 81%. Net heat



INDOOR TURBINE ROOM of Gadsby has Unit 1 in front, Unit 3 in back. Total capability of the units adds to 246,000 kw. Units 2 and 3 run on reheat-regenerative cycle with five bleed points

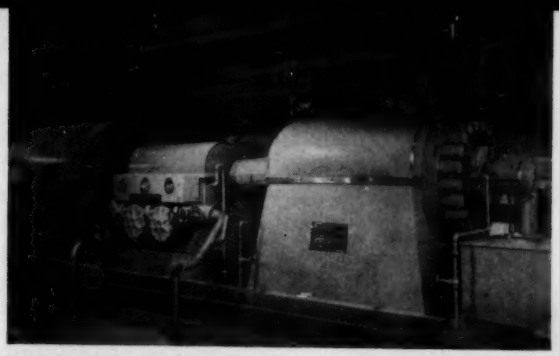
rates for the units were: No. 1—12,570 Btu per kwhr; No. 2—10,960 Btu; No. 3—10,220 Btu per kwhr. Gadsby Plant can produce a net kwhr for an equivalent of 0.89 lb coal; at a fuel cost of 2.63 mills per net kwhr.

Boilers are equipped with water-cooled furnaces, superheaters, reheaters (2 and 3 only), economizers, air preheaters and automatic sequential soot-blowing systems.

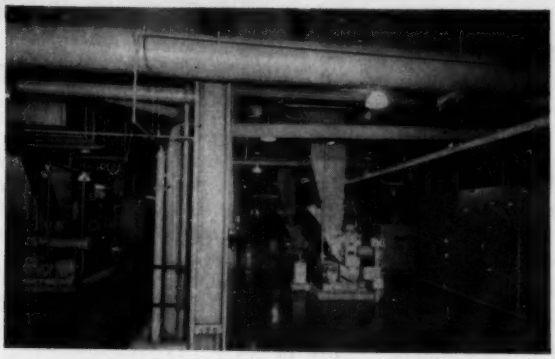
Automatic dampers proportion gas flow over superheater surface to control steam temperature in No. 1. No. 2 uses the same method for primary steam-temperature control plus water-spray desuperheating for emergency control of reheat steam temperature. No. 3 uses burner tilt, gas recirculation and spray desuperheating for emergency control of reheat steam temperature in that sequence, and also spray desuperheating for emergency primary steam temperature control.

Gas recirculation in No. 3 takes gas from economizer outlet and injects it at the furnace bottom. This controls reheat steam temperature down to 30% rating of boiler. The gas-recirculation fan has a shutoff damper in the fan outlet duct and a combination shutoff and control damper in the inlet duct for isolating the fan.

Petroleum pitch, a residue of gasoline- and diesel-fuel refining, is piped from the refinery, 4½ miles north, to three 21,000-bbl insulated storage tanks outside Gadsby plant. The pipeline is made up of a 14-in. OD, 0.188-in. wall, hermetically sealed steel shell with 1½-in. asbestos insulation on the inside. An asphalt wrap covers the out-

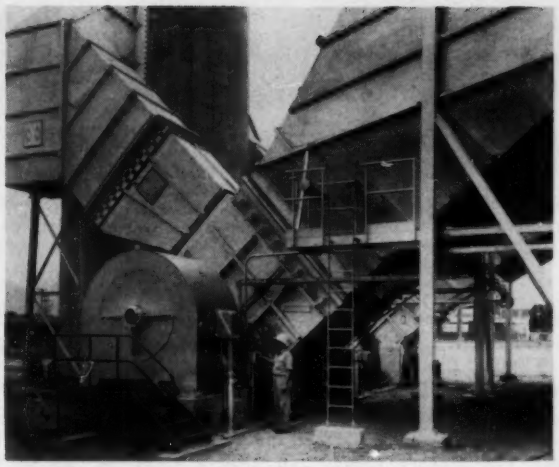


BOILER FEED PUMP of Unit 3 driven by motor through hydraulic coupling delivers 2000 gpm at total head of 4300 ft

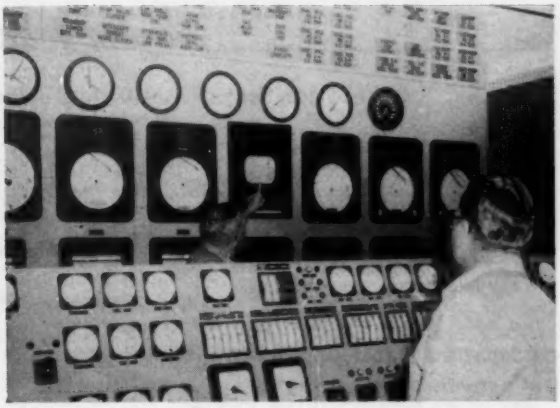


AUXILIARY BAY of Unit 3 stands between boiler and turbine. Coal feeders above pulverizers handle 14 tons per hr

CONTROL ROOM for Units 1 and 2 has 44-kv switchyard controls, *rear;* boiler board, *at right;* turbine board, *at left*

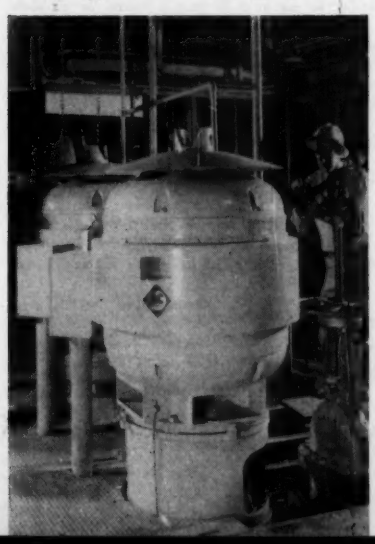


INDUCED-DRAFT FANS for Unit 3, driven by 1000-hp motors, deliver 269,000 cfm of stack gas at 325-F gas temperature

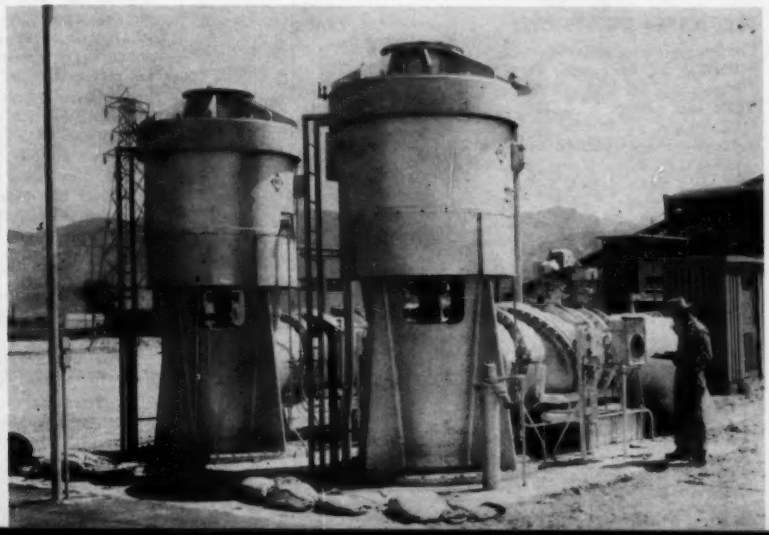


CONTROL ROOM for Unit 3 uses miniature instruments on bench board; TV screen on recorder board; annunciators, top

CONDENSATE PUMPS, for Unit 3, of the vertical type deliver 1450 gpm, 480 ft



CIRCULATING-WATER PUMPS for Unit 3 take 41,000 gpm each from cooling tower and deliver to main condenser at 55-ft head. Cubicle houses the blowdown takeoff



INDUCED-DRAFT COOLING TOWERS for Units 2 and 3 stand near plant, *right, off picture.* Chlorinator and acid equipment stand in front of tower along with outdoor circulating-water pumps, *at right.* Unit 3 cooling tower has a total of 10 cells

side. The line has expansion loops every 700 ft. Inside the shell are a 5-in.-dia pitch transport pipe and a 4-in. steam tracing line. Heat from the tracing line keeps petroleum pitch fluid.

Two recirculation pumps and heaters, five primary pumps and heaters stand in the petroleum-pitch pumping station. Three secondary pumps and heaters stand in the main station building. Petroleum pitch in the storage tanks is constantly recirculated through a heater.

Two primary pumps and heaters serve No. 1 unit, two sets serve No. 2 and the fifth set as a spare can connect to either unit. The 53.5-gpm primary pitch pumps deliver pitch through the primary heater to the secondary pitch pumps in the station. The latter pumps deliver the pitch through the secondary heaters to steam atomizing oil guns at the burners. Average viscosity of the pitch is 600 ssu at 210 F and 65 ssu at 350 F. Temperature of the pitch at the burners ranges from 200 F to 275 F.

PRINCIPAL POWER-PLANT EQUIPMENT

Gadsby Steam Electric Plant—Unit No. 3, Utah Power & Light Company, Salt Lake City, Utah

POWER-GENERATING EQUIPMENT:

Turbine-generator, 1 ..... General Electric Co
105,000 kw, preferred standard, reheat, tandem compound, double flow, condensing, 1450 psig, 1000/1000 F, 2.5 in. Hg, 5 extraction points, 122,994 kva at 15-psig hydrogen pressure

Condenser, 1 ..... Allis-Chalmers Mfg Co
Single pass, horizontal, divided waterbox, 50,000 sq ft, 82,000 gpm cooling water, 3000-gal hotwell capacity

Condenser tubes ..... Chase Brass and Copper Co
7800 tubes, ⅞-in. OD, admiralty, 28-ft effective length

CIRCULATING-WATER EQUIPMENT:

Circulating-water pumps and motors, 2 ..... Allis-Chalmers Mfg Co
Single suction, mixed flow, vertical, 41,000 gpm, 55-ft head, 390 rpm, induction motors, 700 hp, 4160 v, 3 ph, 60 cycle

Cooling tower, 1 ..... The Fluor Corp
Induced draft, counter flow, 82,000 gpm, 10 cells, 20-ft fans driven by 50-hp motors

Cooling-tower makeup pump, 1 ..... Worthington Corp
Vertical, turbine type, single stage, 2200 gpm, 60-ft head, 1750 rpm

Cooling-water makeup pump drive, 1 ..... Westinghouse Electric Corp
50 hp, 440 v, 3 ph, 60 cycle, 1750 rpm

FEEDWATER EQUIPMENT:

Condensate pump and motors, 2 ..... Allis-Chalmers Mfg Co
Vertical pit, centrifugal, 1450 gpm, 480-ft head, 1160 rpm, induction motors, 250 hp, 4160 v, 3 ph, 60 cycle

Boiler feed pumps, 2 ..... Pacific Pumps, Inc
Centrifugal, barrel type, 8 stages, 2000 gpm, 4300-ft head, 3490 rpm

Boiler-feed-pump hydraulic coupling, 2 ..... American Blower Corp
Scoop type, Bailey Meter Co control

Boiler-feed pump drives, 2 ..... Westinghouse Electric Corp
Induction motor, 2500 hp, 4160 v, 3 ph, 60 cycle, 3585 rpm

Feedwater heaters, 4 ..... Westinghouse Electric Corp
Horizontal, U tube, integral drain coolers, No. 1 in condenser neck

Heater	*Sq ft*	*Removable*	*Tube metal*	*Shell press.*	*Tube press.*
No. 1	3850	Bundle	Admiralty	50 psig	300 psig
No. 2	1740	Shell	Admiralty	100 psig	300 psig
No. 4*	3100	Shell	Cupro-nickel	300 psig	2500 psig
No. 5*	3865	Shell	Cupro-nickel	600 psig	2500 psig

*Desuperheating zone

Deaerating feedwater heater, 1 ..... Elliott Co
740,452 lb per hr, vertical, direct contact, tray type, integral spray type, vent condenser, 1330 cu ft storage

Evaporator, 1 ..... Westinghouse Electric Corp
720 sq ft, single pass, horizontal, cupro-nickel tubes, 18,640 lb per hr vapor output, submerged straight-tube thermal descaling

Evaporator preheater, 1 ..... Worthington Corp
Deaerating type, 29,290 lb per hr capacity

STEAM-GENERATING EQUIPMENT:

Boiler, 1 ..... Combustion Engineering, Inc
Single drum, radiant, reheat, 800,000 lb per hr continuous, 1525 psig, 1005/1005 F, 68,700-cu ft furnace, 37,220 sq-ft waterwalls, 2-stage 47,645-sq-ft superheater, 713,000-lb-per-hr 10,220-sq ft reheater, burner tilt, gas recirculation and spray-type desuperheating control, 24,600-sq-ft horizontal finned-tube economizer, 16 adjustable tangential coal burners, 32 adjustable tangential gas burners, and 28 automatic gas igniters

Air preheaters, 2 ..... Air Preheater Corp
Ljungstrom, vertical, 93,400 sq ft each, dual electric, air-motor drive

Steam air heaters, 2 ..... Griscom-Russell Co
Finned tube, 458,100 lb per hr air at 0 F (min), steam- or air-blowing cleaning device

Soot blowers .... Copes-Vulcan Div, Continental Foundry & Machine Co
20 deslagger blowers for furnace walls, 14 long and short retractable for superheater and reheater, 4 rotary for economizer, 450-psig blowing steam, automatic sequential operation

Gas-recirculation fan, 1 ..... American Blower Corp
128,000 cfm, 600 F, 5.69 in. wg, 585 rpm

Forced-draft fans, 2 ..... Westinghouse Electric Corp
171,000 cfm, 100 F, 15.1 in. wg, 1180 rpm, inlet vane outlet dampers

Forced-draft fan drives, 2 ..... Westinghouse Electric Corp
Induction motors, 500 hp, 1190 rpm, 4160 v, 3 ph, 60 cycle

Induced-draft fans, 2 ..... American Blower Corp
269,000 cfm, 325 F, 16.25 in. wg, 707 rpm, inlet-vane louver control, outlet dampers

Induced-draft fan drives, 2 ..... Westinghouse Electric Corp
Induction motors, 1000 hp, 707 rpm, 4160 v, 3 ph, 60 cycle

Precipitator and dust collector ..... Western Precipitator Corp
Integral mechanical type multiclone and Cottrell Electrostatic Precipitator, 24 hoppers

Ash-handling system ..... United Conveyor Corp
Pneumatic with automatic sequential control, 15 tph, 5 clinker crushers, one mechanical exhauster, one steam standby exhauster, two rotary ash unloaders, two air washers interconnected with Unit 2
Ash-storage bin ..... The Lang Co
20 ft dia, 33 ft high

COAL-HANDLING EQUIPMENT:

Car shaker, 1 ..... Link-Belt Co
Reciprocating feeder, 1 ..... Link-Belt Co
Primary coal crushers, 2, 250 tph ..... American Pulverizer Co
Coal samplers ..... The Galigher Co
Sample pulverizers ..... American Pulverizer Co
Coal-handling conveyors ..... Link-Belt Co
400 tph, stacking out conveyors, reclaiming conveyors, automatic telescope chute, belt-conveyor tripper
Belt weightometer ..... Merrick Scale Mfg Co
Magnetic pulleys ..... Dings Magnetic Separator Co
Conveyor belts ..... Thermoid Western Co
Coal scales, 4 ..... Stock Equipment Co
20-tph capacity, 300-lb hopper
Coal feeders, 4 ..... Combustion Engineering, Inc
Coal pulverizers, 4 ..... Combustion Engineering, Inc.
Bowl mill, 27,800 lb per hr coal

PIPING AND VALVES:

Steam and boiler feed piping ..... Midwest Piping Co, Inc
Circulating-water piping ..... The Lang Co
Spring hangers ..... Grinnell Co
Expansion joints ..... Zallea Brothers

High-pressure gate, check valves:
- Chapman Valve Manufacturing Co
- Crane Co
- Wm Powell Co
- Pacific Valves, Inc
- Edward Valves, Inc
- Manning, Maxwell & Moore

Steel gate, globe, check valves:
- Chapman Valve Mfg Co
- Crane Co
- Manning, Maxwell & Moore
- Edward Valves, Inc
- Pacific Valves, Inc
- Wm Powell Co

Instrument valves:
- Wm Powell Co
- Edward Valves, Inc

Iron and bronze valves:
- Chapman Valve Mfg Co
- Crane Co
- Wm Powell Co

Plug valves ..... Rockwell Mfg Co
Relief valves ..... Manning, Maxwell & Moore
Bleeder trip valves ..... Atwood & Morrill Co
Butterfly valves ..... Henry Pratt Co

Pressure controllers and control valves:
- Fisher Governor Co
- Leslie Co

Solenoid trip valve ..... Automatic Switch Co
Cooling-tower blowdown valves .... Minneapolis-Honeywell Regulator Co

Steam traps and strainers:
- Armstrong Machine Works
- Yarnall-Waring Co

Service-water strainers ..... Andale Co

MISCELLANEOUS PUMPS:

Steam air-heater drip pump, 1 ..... Ingersoll-Rand Co
2-stage, vertical, centrifugal, 50 gpm, 335 F, 240-ft head, 3500 rpm
Lube-oil filter circulating pump ..... Bowser, Inc
Herringbone gear positive displacement, 10.4 gpm, 1150 rpm
Acid-free pump, 1 ..... Milton Roy Co
Simplex plunger, motorized, stroke adjustment, 19.5 gph, 5 psig, 48 strokes per min
Sodium-aluminate feed pump ..... Milton Roy Co
Simplex plunger, screw stroke adjustment, 4.5 gph, 5 psig, 48 strokes per min
Water-treating acid pump ..... Milton Roy Co
Simplex plunger, screw stroke adjustment, 30 gph, 60 psig, 74 strokes per min
Service-water pump ..... Allis-Chalmers Mfg Co
Horizontal, centrifugal, single stage, 2500 gpm, 50-ft head, 1750 rpm, 40-hp drive motor, 440 v, 3 ph, 60 cycle
Raw-water pump ..... Worthington Corp
Vertical turbine type, single stage, 1800 gpm, 63-ft head, 1750 rpm
Raw-water-pump drive ..... Westinghouse Electric Corp
40 hp, 440 v, 3 ph, 60 cycle, 1750 rpm
Air-washer circulating pumps, 2 ..... Carver Pump Co
532 gpm, 70-ft head, 1750 rpm

MISCELLANEOUS EQUIPMENT:

Combustion and feedwater controls ..... Bailey Meter Co
Miniline, pneumatic type, console board, recorder panel, oxygen analyzer panel
Television ..... Diamond Power Specialty Corp
Closed circuit, 115 v, 60 cycle, 75 mm, f2.7 camera lens, air cooled
Turbine lube-oil filter and conditioner, 1 ..... Bowser, Inc
Air compressors, 2 ..... Ingersoll-Rand Co
Horizontal single stage, double acting, 211 cfm, 100 psig
Air-compressor drive, 2 ..... Westinghouse Electric Corp
Air drier, 1 ..... Pittsburgh Lectrodryer Corp
Dual tower, activated alumina as desiccant
Water-treating equipment ..... Permutit Co
Two hydrogen zeolite softeners, one degasifier, treat 55 gpm
Chemical injection drum ..... Babcock & Wilcox Co
14-in. OD by 5 ft long, 2500 psig, 650 F
Fire protection—carbon dioxide system ..... Walter Kidde and Co, Inc
Fire protection—sprinkler system ..... Western Automatic Sprinkler Co
Hoists, miscellaneous ..... American Chain & Cable Co
Tanks, miscellaneous ..... The Lang Co
Air washers, 2 ..... Air and Refrigeration Corp
Ventilating-supply fans, 2 ..... Joy Mfg Co, Inc
Exhaust fans, 5 ..... Chicago Blower Corp
Exhaust fans, 5 ..... Penn Ventilator Co
Heating coils, 12 ..... Aerofin Corp
Air-conditioning units ..... The Trane Co
Compressors and condensers

ELECTRICAL EQUIPMENT:

Main transformer ..... General Electric Co
125,000 kva, 13.2/132 kv
Station service transformers ..... Westinghouse Electric Corp
7500 kva, 13.8/4.16 kv
Crankup transformer ..... Westinghouse Electric Corp
7500 kva, 43.8/4.16 kv
Isolated phase bus ..... I-T-E Circuit Breaker Co
14.4 kv, 6000 amp, extruded aluminum hollow-square conductors, aluminum enclosures
Oil-filled pipe-type cable ..... The Okonite Co
138 kv, 133,689 kva, 138-kv oil circuit breaker to main transformer
Main oil circuit breaker ..... Allis-Chalmers Mfg Co
Pneumatic operated, 138 kv, 1200 amp, 3 pole, 3,500,000 kva, 5-cycle interrupting capacity
Crankup oil circuit breaker ..... General Electric Co
Oil blast, pneumatic operated, 1200 amp, 190,000 kva, 8 cycle interrupting capacity
Excitation switchgear ..... General Electric Co
Formed steel, indoor, dead-front structure
Generator neutral grounding switchgear ..... General Electric Co
Formed steel, transformer rating, 25 kva
4160-v switchgear, 19 units ..... General Electric Co
High voltage, metalclad, indoor, dead front, vertical lift
480-v load center, 3 ..... Westinghouse Electric Corp
Turbine supervisory board ..... General Electric Co
Steel enclosed, dead front, one unit
Station relay board, 2 ..... General Electric Co
Formed steel, 3 sections, double doors in rear of each section
125-v dc switchgear ..... Western Switchboard Co
Instrument ac panelboard ..... Westinghouse Electric Corp
Lighting panelboard ..... Westinghouse Electric Corp
Lighting distribution unit, 75 kva ..... General Electric Co
Street lighting ..... Westinghouse Electric Corp
20-kw transformer, photo-electric relay operated
Station storage battery ..... Electric Storage Battery Co
60 cells, 125 v, 320 amp-hr at 8-hr rate to 1.75 v per cell
Battery-charging m-g sets, 2 ..... Electric Products Co
Diverted pole, 3-kw generator, 129/140 v dc, 5 hp, 1800 rpm, 440 v, 3 phase, induction motor
Annunciator system ..... Western Switchboard Co
Telephone system ..... Stromberg Carlson Co
Pipe heating system ..... Allis-Chalmers Mfg Co

Engineers and constructors ..... Bechtel Corporation

By **DONALD B HOWARD**
Research and Development Dept
ACF Industries, Inc

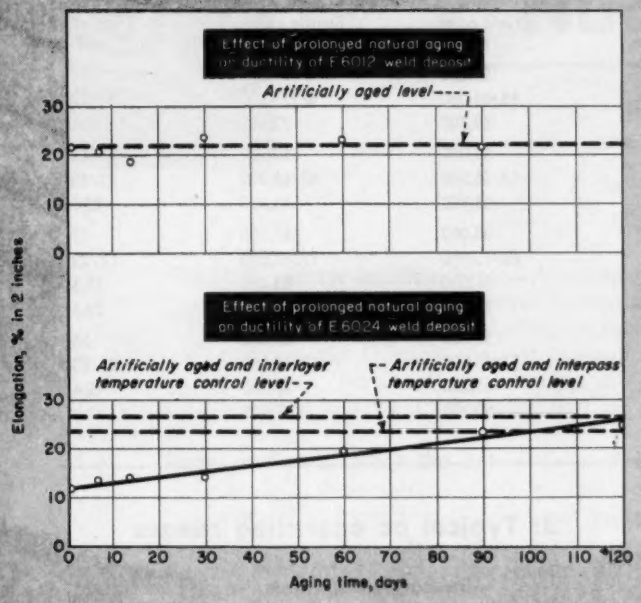
Complete penetration, low porosity and predetermined ductility level are now proved by laboratory tests. For production or maintenance welding, the following techniques spell out how to . . .

Get results from

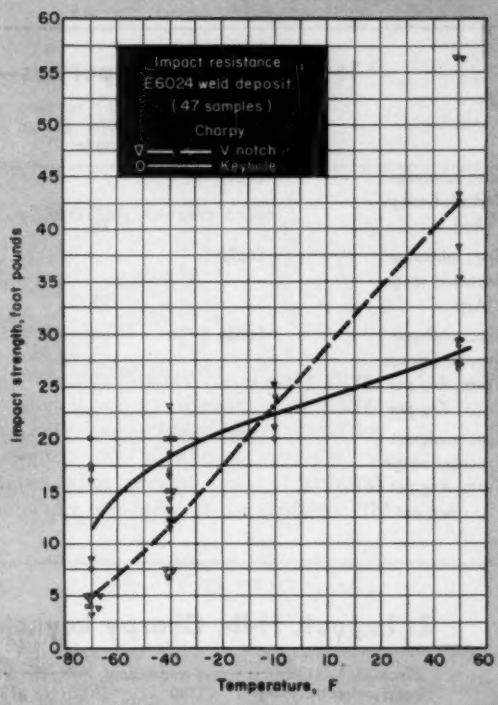
► AMERICAN-MADE iron-powder coated electrodes hit the market in 1953 with considerable fanfare. By coincidence, our management had just approved a plan for continuous appraisal of electrodes used in our shops. The plan would let us test and evaluate, thus consistently give us the best-quality electrode at lowest possible cost. So we were set up to put this new-type electrode through the wringer.

Horizontal fillet welds comprise 85% of our linear footage of manually welded joints. With this as a basic approach, we used the standard evaluation method found in the ASTM A-233-48T (Same as AWS A5.1-48T) Tentative Specifications for Mild Steel Arc-Welding Electrodes. This specification was revised in 1955 and is now known as 55T rather than 48T. Many of our tests were completed before formal adoption of 55T requiring further evaluation to learn the effects of the specification changes.

Major differences between 48T and


Effect of prolonged natural aging on ductility of E 6012 weld deposit
Artificially aged level
Effect of prolonged natural aging on ductility of E 6024 weld deposit
Artificially aged and interlayer temperature control level
Artificially aged and interpass temperature control level
Elongation, % in 2 inches
Aging time, days

1 Satisfactory impact test values show comparison between Charpy keyhole and the more sensitive V notch specimens



2 Ductility levels show advantage of artificial aging over natural aging of iron-powder coated electrode deposits

the new iron-powder coated electrodes

55T are (1) temperature control techniques used in preparing the all-weld-metal tension test specimens and (2) specimen aging techniques prior to testing.

We compared the new, then unclassified rutile and iron-oxide iron-powder coated electrodes by checking them against several conventional E6012 and E6020 electrodes. Our investigation covered:

1. Fillet weld fracture and dimensional tests.
2. Guided-bend tests.
3. All-weld-metal tension tests.
4. Impact resistance tests.
5. Macro- and micro-examination.
6. Operating characteristics.

The results indicated the following as shown in Table 1, p 82:

1. Average actual yield and tensile strengths are much higher than the minimum requirements for E6024 (rutile type iron-powder coated) electrodes.

2. Expected mechanical properties for E6027 (iron-oxide type iron-powder coated) electrodes are realistic.

3. Interlayer temperature control, used to prepare all-weld-metal tension test specimens, improves elongation.

4. Artificial aging of all-weld tension test specimens improves elongation.

Impact resistance test values for Charpy keyhole specimens, table 2, were satisfactory. The more sensitive Charpy V-notch test specimens gave less favorable values as shown in Fig. 1.

Macro- and micro-examination showed sound weld deposits. Further, only one failure occurred during our many guided-bend tests. To get proper penetration and acceptable porosity welds, however, we found the operating current range narrower, table 3, for iron-powder coated than for conventional-type electrodes.

These data are not colored by opinion, but are the results of our extensive experimental testing. Despite what appeared to be exaggerated claims for the new-type electrodes, we realized that advantages existed. We wanted to understand the limitations and take advantage of desirable characteristics.

Engineers usually design to a service requirement, which may temporarily exceed the yield strength of the material. Under some shock impact conditions, plastic deformation must occur or the material will fail. Consequently, ductility is of prime importance in our electrode evaluation. Based on design experience, we chose arbitrary levels of ductility as expressed in percent elongation in 2 in.

We know that, as a result of other test data submitted to the ASTM-AWS Filler Metal Committee, the ASTM Specification spells out minimum elongation values expected for both conventional and their iron-powder coated counterparts as follows:

E6012	17% in 2 in.
E6020	25% in 2 in.
E6024	17% in 2 in.
E6027	25% in 2 in.

"Booster" techniques must be used

1: Mechanical properties—conventional vs iron-powder coated

	Electrode classification	No. samples	No. brands	Yield point, psi	Tensile strength psi	Elongation % in 2 in.
Spec minimum	E6012			55,000	67,000	17
Expected range				55/65,000	68/78,000	17/22
Avg		26	5	62,700	72,900	18.5
Spec minimum	E6020			50,000	62,000	25
Expected range				52/58,000	62/68,000	25/30
Avg		22	4	56,900	65,200	22.5
Spec minimum	E6024			55,000	67,000	17
Expected range				65/75,000	77/87,000	17/22
Tests: Avg per 48T		65	5	81,000	88,200	10.8
Avg per 55T				75,000	81,700	24.3
Spec minimum	E6027			50,000	62,000	25
Expected range				52/58,000	62/68,000	25/30
Tests: Avg per 48T		46	4	63,200	70,500	19.4
Avg per 55T				59,400	67,800	27.8

2: Impact, ft-lb, Charpy keyhole

Electrode classification	Temperature, F +70	−40	−70	−100
E6012				
Spec guide	20/30	15/20	—	—
Tests	21/30	4/23	—	2/20
E6020				
Spec guide	20/30	15/20	—	—
Tests	23/28	16/24	—	14/23
E6024				
Spec guide	20/35	15/20	—	—
Tests	18/33	13/24	3/25	3/15
E6027				
Spec guide	25/35	20/30	—	—
Tests	26/36	22/28	15/26	—

3: Typical ac operating ranges

¼-in. horizontal fillets

¼-in. conventional electrodes

3/16-in. iron-powder coated

Electrode classification	Amp
E6012	285/345
E6020	285/345
E6024	275/305
E6027	250/280

to get such ductility levels from the iron-powder coated electrodes, E6024 and E6027. These techniques include *interlayer* instead of *interpass* temperature control and *artificial* instead of *natural* aging. For example, with the E6024 electrode, using ac current and stringer pass or "drag" technique, we get the following:

Temp control 2 in.	Aging, F	Elong, %, in
Interpass	75	13
Interpass	210	22
Interlayer	75	17
Interlayer	210	28

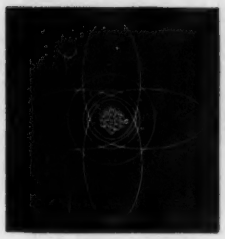
We set up, as minimum acceptable quality for electrode use and purchase for some specific applications, a ductility level of 13% elongation in 2 in. from machined specimens prepared using interpass temperature control, natural aging and tested on the seventh day after welding.

Some people feel that artificial aging is misleading and is not practicable for most production applications. But our work clearly indicated, Fig. 2, p 81: ductility levels of specimens prepared using either interlayer or interpass temperature control technique and artificial aging were immediately higher than the 17% minimum required by the ASTM Specification 55T. On the other hand, specimens prepared using both interpass temperature control and natural aging didn't reach the 17% minimum ductility level until after two months. Further, these latter specimens were still below the interlayer temperature control with artificial aging ductility level after 120 days.

Artificially aged tensile specimens made with conventional electrodes show little difference in elongation from those aged for even short periods at room temperature; also Fig. 2. In definite contrast, artificial aging of iron-powder coated electrode deposits shows marked increase in ductility. Knowing the magnitude of the aging phenomenon, one can establish safe ductility levels for weldments that can't be artificially aged in production. By predicting the ultimate ductility level of an iron-powder coated electrode deposit, one can govern service limitations during the period ductility is improved by natural aging.

Two characteristics of these new, fast electrodes are dangerous if not kept under control. Fortunately, one is dependent on the other. One is the rather limited current range that produces good sound welds with adequate penetration. The other is the deception of sound-appearing horizontal fillets with the inherent possibility of excessive root porosity.

(*Continued on page* 222)



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

First U.S. reactor accident happened to Experimental Breeder Reactor No. 1 near Arco, Idaho on Nov 29, 1955. Oral instructions, to shut down the reactor immediately, were misunderstood. Overheating damaged the core and released some radio-activity in the building. Prompt evacuation prevented any significant exposure of personnel. Extent of core damage will be known when present work of removal has been completed. Probably part of core structure will have to be replaced.

Latest estimates place the age of the earth and the meteorites at about 5 billion years. Scientists base this on study of radioactive decay of U-235, U-238, Th-232, potassium-40 and rubidium-87. All seem to agree closely.

Organic Moderated Reactor Experiment (OMRE) will be built by Atomics International of North American Aviation, Inc for Atomic Energy Commission. AI will pay about $750,000 of total $1.8 million cost. Diphenyl (a carbon-hydrogen compound) acts as both moderator and coolant. Its advantages: (1) High hydrogen content makes good moderator. (2) Diphenyl boils at high temperatures—needs only low pressures for circulation. (3) It corrodes standard structural materials only very slightly. (4) Doesn't react readily with U. (5) Becomes only slightly radioactive. Problems to be solved deal with effects of heat and radiation that tend to deteriorate the liquid.

Atomic-propelled tanker bids have been received by the Maritime Administration. Four firms have offered to build a pressurized-water-reactor power plant to run by June 1959. Nine firms have offered to do advanced studies for a closed-cycle gas-turbine plant powered by a gas-cooled reactor to run by 1961. Either ship would be 38,000 tons dead weight, run at about 21 knots. Maritime has asked Congress for $22.5 million to finance the project. First ship can be built for this amount—second one would take more money, need longer time to build.

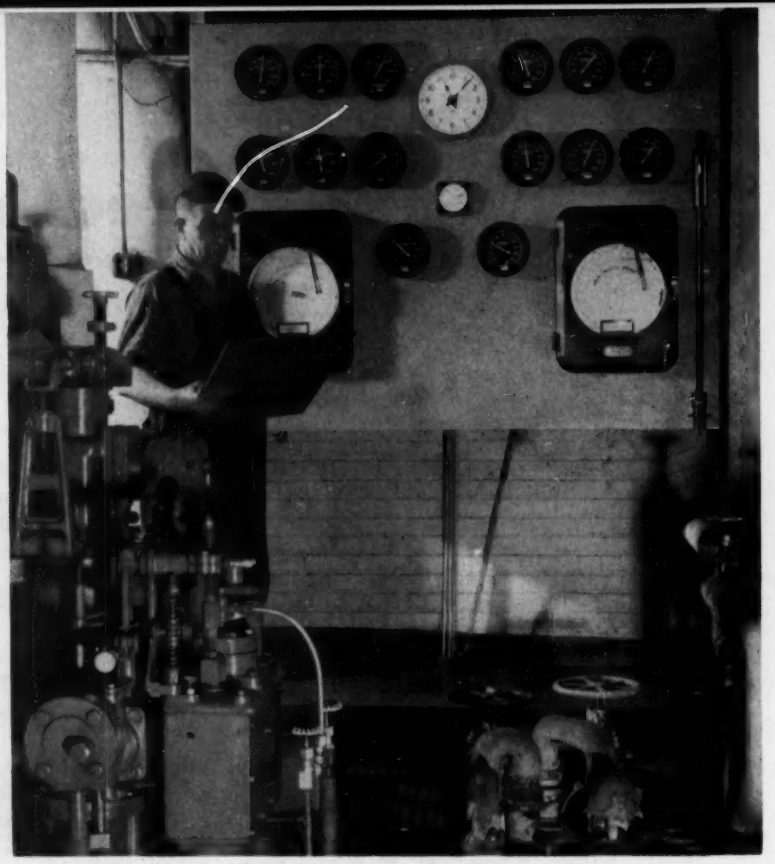
Insurance needs for third-party liability in reactor accidents apparently cannot be completely covered by insurance industry at present. Federal help seems to be urgently needed to solve this problem. Philip Sporn, president of American Gas & Electric Company, believes within a very short time, nearly all nonfederal activities will be badly delayed, even stopped completely, unless third-party liability problem is faced now.

High cost of atomic plants was stressed by F K McCune of General Electric Company in testifying before Joint Congressional Committee. Talking about 180,000-kw boiling-water reactor they are building for Commonwealth Edison Company he said, ". . . the $45-million price . . . does not cover all we expect to spend on this project . . . if we obtain no further business we will have lost substantial sums."

Nautilus operation has propelled submarine 26,000 miles on present nuclear-fuel charge. Navy expects it should go that far again before refueling.

Want to change the color of your diamond? Have it irradiated in a reactor, or bombarded in a particle accelerator. The former may produce a green color, which may be turned to brown under certain heating conditions. The accelerator may produce a blue or blue-green color. Reactors make diamonds radioactive temporarily, but this decays to an insignificant level within a few days.

CASE STUDY:
A '55 AWARD WINNER —
THE GARLOCK PACKING CO



OPERATOR CHECKS READINGS on Garlock's new turbine-control panelboard

Now, their power services are tops

Garlock was fenced in by

- growing steam, electrical loads
- an unfavorable heat balance
- inadequate electrical distribution
- obsolete hydraulic-power equipment
- overloaded compressed-air system

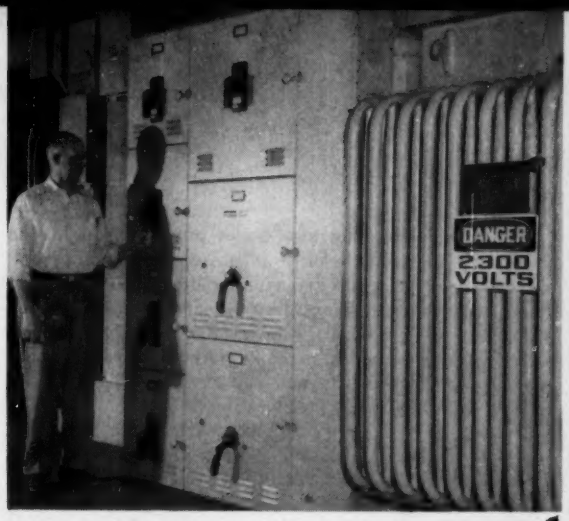
They took decisive action

- called in Consultant Sforzini for a top-to-bottom survey, and then followed up his proposals

Results . . . they're impressive

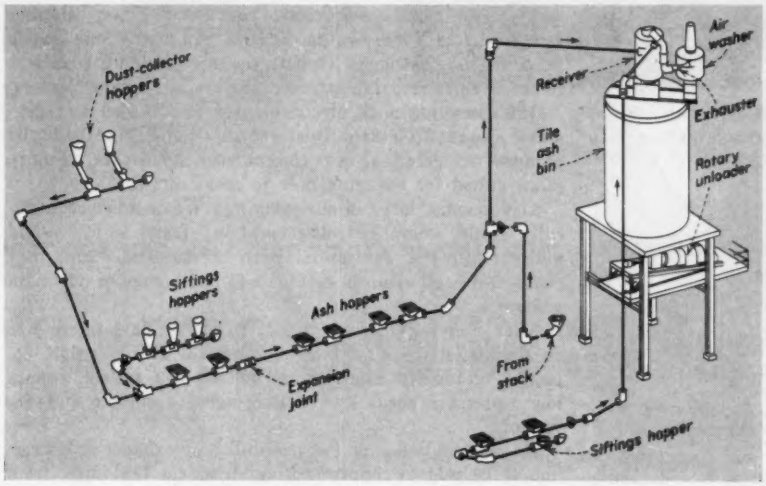
- an across-the-board revamping of the power services that meets the plant's climbing production needs reliably and economically

By H R SPANGANBERG
Chief Power Engineer, The Garlock Packing Co
L J SFORZINI
Consulting Engineer

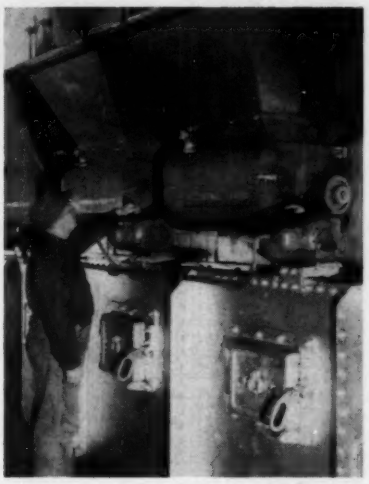


AUXILIARY-POWER LOAD CENTER for the power plant is 1000 kva, connected to one of four generated power breakers

3000-KW TURBINE is extraction-condensing design. The 150-psig extraction point supplies process and heating steam



PNEUMATIC ASH HANDLING includes a separate run of ash-discharge pipe from the new boiler. Pipe runs to new target box that discharges into the ash silo



BOILER is spreader-stoker fired. Cinder reinjection improves unit efficiency

'We were blowing sizable amounts of l-p steam to atmosphere.'

► By 1951, our steam loads at Garlock had climbed to such an extent that we weren't able to take our biggest boiler off the line. Even minor repairs and required legal inspections meant curtailing production. Major maintenance work had to be put off—at a time when demand for our company's products was on the upswing. Also dimming our steam-producing picture was the poor efficiency of smaller boilers coupled with steadily rising coal costs.

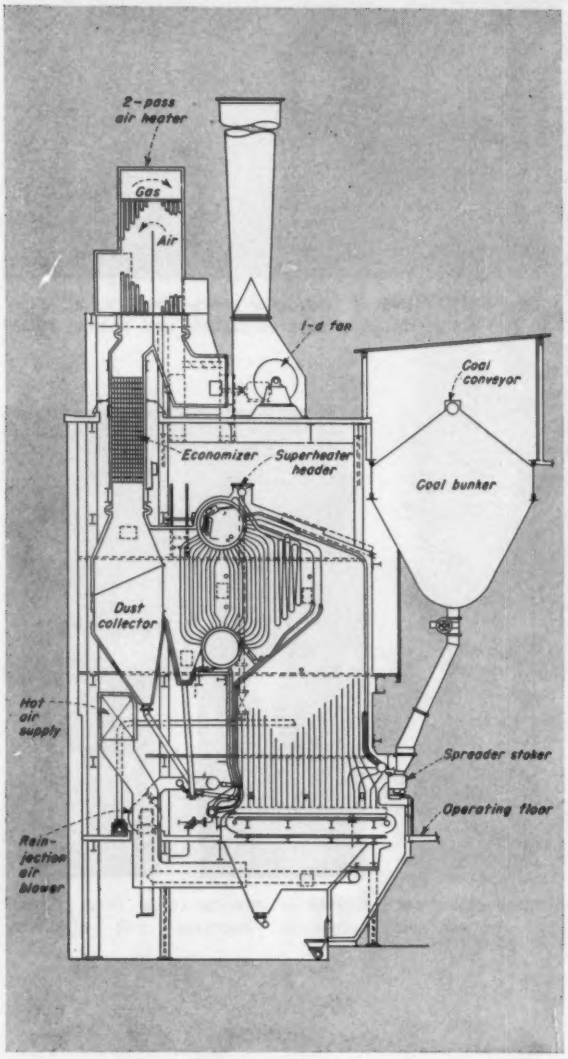
Our plant is at the end of a long utility line. And while the utility had a good record for maintaining continuous service we felt that the key role played by electrical power in our plant called for at least partial self-generation.

At light loads we had to condense as much as 6500-lb-per-hr steam from the existing 1000-kw extraction-condensing turbine—even though there was enough extraction-steam demand to generate all our power. Here's why: 70-psig extraction steam provided too low a pressure for rubber-curing operations. So we had to get needed pressure by reducing 400-psig boiler steam.

Poor plant heat balance was mainly due to (1) exhausting 10-psig steam from steam-driven hydraulic pumps (2) flashing steam from high-pressure presses. Conditions improved a bit after recent installation of a low-pressure turbine and small condenser, to drive a service-water pump. But continued plant growth meant we were still rejecting large quantities of l-p steam to the atmosphere.

Old distribution breakers deteriorated. We had already replaced the generator- and purchased-power breakers with up-to-date air breakers. And some loads were switched over to 2300-v purchased power only. Now our aim was to modernize the distribution breakers, connect all load centers to purchased as well as generated power.

Direct-acting steam-driven pumps, powering 2000- and 3500-psig hydraulic systems needed heavy maintenance. Our



100,000-LB-PER-HR BOILER operates at 425 psig, 600 F. Auxiliaries include: air heater, economizer, dust collector

'Cinder reinjection boosts our stoker firing efficiency.'

long-range plan called for swinging some presses over to self-contained hydraulic systems, powering remaining presses from motor-driven pumps.

More boiler capacity now—and in future—was a must item. Careful study showed that a 100,000-lb-per-hr 425-psig 600-F unit, spreader-stoker fired, with cinder reinjection from dust collectors and boiler passes, would be our best bet. This unit could normally operate alone, with three older units as standby. And we'd still have enough slack to handle a 20,000- to 25,000-lb-per-hr load growth.

Key factor in pegging new boiler pressure close to the existing 400-psig: We wanted to use old feed pumps and feed system; 600-F upper temperature limit meant we could bypass steam without using desuperheaters.

Space for our new boiler was hard to come by. But old steam hydraulic pumps (to be replaced) occupied a bay opposite two older boilers and had access to the overhead bunkers. Deciding in favor of locating the new boiler in this limited-area bay meant putting vertical area to work. As a result, boiler design looks like this: Dust collector is in rear of boiler. Combustion gas flows up through an economizer that extends above the roof level. Upflow continues through first pass of the air heater. Second gas pass is downward to an induced-draft fan on the boiler-plant roof. Fan discharges to a short roof-mounted stack, sketch at left.

Cinder reinjection, from dust collectors and boiler passes, gives us top stoker-firing efficiency. High-speed high-pressure blower with 50-hp 3600-rpm motor drive, supplies reinjection air. Suction is from a protected zone inside the front ash-discharge hopper. Cyclone cleaning separator removes entrained ash particles before they enter blower.

Our combined peak electrical load (purchased and generated) was 2700 kw. But we were powering hydraulic pumps, refrigeration, air compressors by steam. Future plans called for swinging over to motor drives.

Also looming large in our thinking: We couldn't economically justify complete self-generation. Local utility would always supply a substantial part of the load. And they could also back us up in case of a forced outage of our main generator.

After studying different turbine types we gave the nod to an extraction machine, extracting steam at 150 psig. We plan to gradually eliminate the old 70-psig system, supply lower pressure needs by reducing valves from the 150-psig system.

We also mulled over the possibility of exhaust or extraction at 10 psig to supply heating steam for buildings, feedwater. But a second look showed that we'd be getting an unfavorable heat balance a good part of the time. Result: Turbine we finally picked is extraction condensing, with minimum flow to the condenser. If necessary, full kva output of the generator can be handled on a straight condensing basis. Cooling-tower installation meets condenser cooling-water requirements.

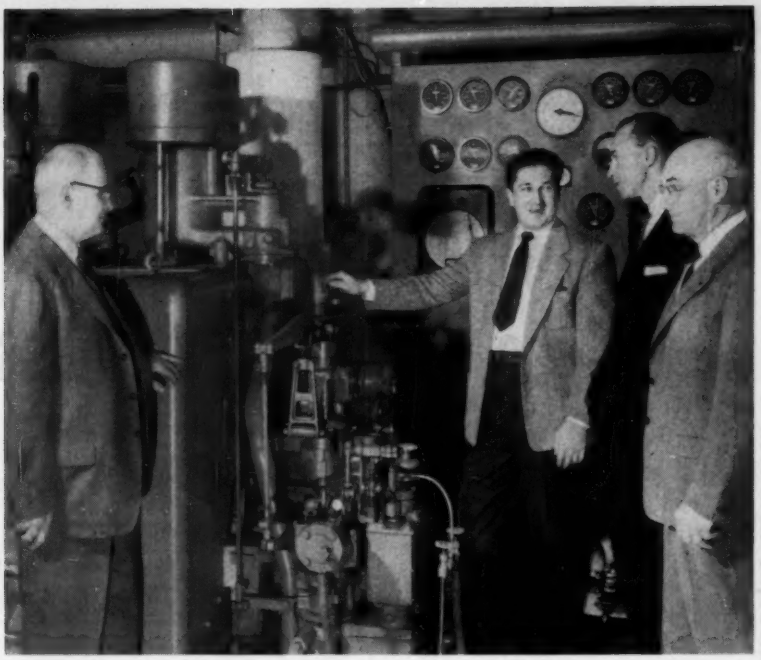
Ordinarily we'd have chosen a 4150 generating voltage for a plant of this size. But since there was already quite a bit of 2300-v distribution, we settled on the lower voltage. Turbine size is 3000 kw coupled to 3750-kva generator.

Space for our new turbine-generator wasn't easy to find either. Small area, east of the existing turbine room was vacant above ground, but congested with pipes, other services underground. By relocating some of these lines, installers found room for turbine, other foundations.

Condenser is at right angles to the turbine axis—with practically no clearances between condenser, foundations and piping. We had to jack the condenser in place, install supporting steel lugs under it and bolt them to the turbine foundation.

Old 1000-kw machine is standby, should our new unit be off the line when a utility outage occurs. We're also using it to make sure we don't hit excessive purchased power peaks, keep demand charges to a minimum.

For details on the solution to Garlock's electrical-distribution and hydraulic-power problems, see POWER, *Mid-Sept 1955 Modern Plant Yearbook Issue, pp 74, 95.*



ADMIRING A '55 AWARD-WINNING PROJECT at The Garlock Packing Co are *(l to r)* Lewis J Sforzini, Consulting Engineer; R Buss, Operating Engineer, H Kallen, Associate Editor of *Power;* H R Spanganberg, Chief Power Engineer, with Garlock

Garlock and 23 other smart modernizers copped awards in '55 . . .

'56 could be the big year for you

► YES, '56 could be the big year for you—and your entire plant—if you've recently modernized one or more of the power services. And here's why:

As part of a continuing policy to give national recognition to smart modernizing, show future planners what today's best practices are, POWER invites you to enter its 1956 Modernization Award Program. It's your big chance to help yourself and your associates to well-earned recognition, across the country as well as in your own plant. But time is fast running out. Closing date for entries is May 15th. So sit down right now, read the simple rules below, and send for an entry blank.

Who is eligible? Industrial, institutional or utility plants may enter if they've modernized one or more power services—boiler plant, generating equipment, electrical distribution, process or building heating, air conditioning, refrigeration, compressed air, mechanical power transmission or water services. Plants may be steam, diesel or hydro.

Most entries will come from members of power-service staffs and consulting engineers. But we'll welcome leads from anyone in the power field.

How we judge. In selecting award winners, POWER's editors are assisted by advisory experts. We look for sound engineering judgment, operating gains and dollar savings —and for ingenuity used in solving problems. Small plants will get the same consideration as big ones.

To ENTER just say "I'd like a 1956 Award blank. Address:

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Award winners will be announced in 1956 Mid-Sept Modern Plant Issue.

HOW TO ORGANIZE YOUR NEW POWER PLANT — 23

Four water-treatment methods to remove algae, hardness and dissolved solids

Chlorination, softening, distillation, cation-anion exchange complete the external treatment for boiler water. Here are details on when these processes are used, how they operate

By D C SWIFT, *Ebasco Services Incorporated*

► THE METHODS of cleaning and clarifying water, described in Number 22 of this series, were relatively simple. Now we come to the more complex equipment to check algae growth, purify water for drinking, remove hardness and dissolved solids that would otherwise produce objectionable deposits in the boiler.

CHLORINATION

In power plants, chlorination prevents growth of algae slimes on heat-transfer surfaces. Other uses are sterilizing drinking water and helping remove dissolved iron from waters.

Liquefied chlorine gas is the least expensive and most widely used agent for this service. Calcium hypochlorite (known as bleaching powder in its less pure forms) is also used for less extensive or temporary systems. Free chlorine is released when the hypochlorite dissolves in water. Although more expensive, the powder is safer and easier to handle.

No matter what form you use it in, remember that chlorine is a strong and dangerous irritant to eyes and lungs. Use proper care and equipment in handling it.

When free of water, chlorine can be stored in steel containers or passed through steel valves and piping without trouble. When dissolved in water it forms hypochlorous acid, which is very corrosive to most metals. Silver, glass and rubber resist its action.

Chlorine is usually received in 100-, 150- or 2000-lb steel cylinders. You need means for unloading and handling the larger cylinders and racks or saddles to hold them in place. The smaller cylinders are usually used standing on end, while the 2000-lb ones are best laid down.

Gas or vapor pressure in a cylinder depends on the liquid temperature. As gas is released, heat of vaporization is removed from the liquid; its temperature is soon so low that the liquid solidifies. Further vaporization then depends on conducting heat into the cylinder through its external surfaces. To prevent freezing, hook enough containers in parallel so required volume is produced without freezing. You can use 400 to 500 lb per day from the ton containers, and proportionally less from the smaller cylinders.

If outside temperature may fall below zero, keep the cylinders being used indoors. In very warm locations subject to direct rays of the sun, cylinder temperature may rise to 140 F or higher unless natural ventilation is good. This may raise chlorine pressure high enough to break the excess-pressure disk. But with ordinary air circulation, outdoor use in warm climates is OK.

All cylinders on a common manifold should be kept at the same temperature. If one is cooler, condensation from gas drawn from the others may fill it dangerously full.

If chlorine is stored or used indoors, provide adequate mechanical ventilation. Remove the heavy gases through a duct with intake near the floor. Outdoors, natural-air currents normally prevent dangerous gas concentration. Provide gas masks at easily reached locations for use in case of a leak or break.

Chlorine combines directly with many organic materials and some bacteria. Next, it reacts to oxidize inorganic materials like ferrous hydroxide or hydrogen sulfide. After these requirements are satisfied, an excess of chlorine may be built up in the water. This attacks the remaining bacteria that may be either dangerous to health or the cause of algae growth. It takes varying levels of residual chlorine to effectively kill the different forms of algae. The usual types are controlled by a few minutes' periodic exposure to 1 to 2 ppm chlorine residual.

As dosage is increased, residuals also increase but not in proportion to the excess added. Then residuals decrease or show no increase until you reach the *break point*. After this, the residual rises once more in proportion to the amount being fed. Reaching or exceeding the break point usually indicates a complete reaction. But it is not always necessary to reach this point to control troublesome algae.

Algae growth depends mainly on water type, temperature, amount of light and type of algae present. Intermittent chlorine feed is as effective, and possibly even more effective, than continuous feed. It is also much more economical.

Continuous feed seems to build up increasing chlorine resistance unless rather high residuals are maintained. So chlorine is usually fed to circulating-water systems for 15 minutes to one hour at intervals of 4 to 24 hours.

Feeding chlorine or hypochlorite solutions may be controlled manually or by automatic program-operated chlorinators. The gas is usually dissolved by passing it through a water ejector where it comes into intimate contact with the water and is rapidly absorbed. Then the hypochlorous acid or hypochlorite solution formed mixes with the main water stream, preferably near condenser or other heat-exchanger inlet. Much chlorine is released if the water is aerated, passed over a cooling tower, etc.

As chlorine gas is withdrawn from the cylinder, the remaining liquid cools and pressure falls. So you need an indicator and possibly a pressure regulator for gas delivered to the mixing jet. Pressure gages used should have a diaphragm to prevent chlorine from contacting gage internals.

The water jet or aspirator adjustment frequently produces a vacuum at the point of chlorine admission. This lessens chances for leakage to the outside air. Many chlorinators are metered to indicate the feed rate. If water flow rate varies, feed rate may be varied proportionally.

Give some thought to the piping and valve arrangement and materials between chlorine-gas admission and the aspirator. Since water readily absorbs the gas, a vacuum may form between gas shut off and water contact. This will draw hypochlorous solution back up the pipe to the gas shutoff point. To handle the problem, simultaneously shut off water and solution pipes, shut off gas and flush the solution pipes, or vent the gas pipe.

Piping, pipe joints, valve stuffing boxes and bottle connectors may permit chlorine leakage. Move valves daily to prevent stems from corroding and sticking.

You can spot chlorine leaks with a small bottle of ammonia. It gives off heavy white fumes in the presence of chlorine. Another way to detect harmful quantities is by smell. Repair leaks promptly.

Use ammonia as a counterirritant if chlorine has been taken into the lungs. But be careful; the cure may be almost worse than the disease. Wear an approved gas mask if there is any chlorine in the air. After heavy exposure remove the patient to pure air. Keep him quietly on his back and call a physician at once.

SOFTENING

Various metallic ions, chiefly calcium and magnesium, cause hardness in water. Softening removes or alters the character of these ions.

If the calcium or magnesium is combined with the bicarbonate ion as $Ca(HCO_3)_2$ or $Mg(HCO_3)_2$, heating the water to the boiling point drives off much of the CO_2 present, changing the elements to $CaCO_3$ or possibly $Mg(OH)_2$ and $MgCO_3$. The former is almost insoluble and precipitates from the water as a sludge or scale. Magnesium carbonate is not so insoluble and is not ordinarily precipitated by heat, but magnesium hydroxide is practically insoluble. So magnesium may also be removed by heating and possibly by addition of some alkaline chemical. If water is not treated beforehand, this action will probably produce scale in the boiler.

Lime-soda softening. Most water softening is done by chemical reaction, usually involving lime and soda ash. You can soften either cold or hot water. Hot water gives faster settling and more complete reactions, but involves some heat loss.

The lime, either as CaO or slaked lime $Ca(OH)_2$ reacts with the calcium bicarbonate $Ca(HCO_3)_2$ to form insoluble calcium carbonate $CaCO_3$, and with the magnesium bicarbonate $Mg(HCO_3)_2$ to form insoluble magnesium hydroxide $Mg(OH)_2$ and calcium carbonate $CaCO_3$. Lime further reacts with some non-carbonate forms of magnesium hardness; notably, magnesium sulfate $MgSO_4$ and magnesium chloride $MgCl_2$.

To get rid of the calcium noncarbonate hardness originally present, plus that converted from magnesium forms, soda ash, Na_2CO_3, is used. This reacts with the usual noncarbonate impurities, calcium sulfate, $CaSO_4$, or calcium chloride, $CaCl_2$, to form insoluble calcium carbonate and either sodium sulfate, $NaSO_4$, or sodium chloride, NaCl, both of which are highly soluble and will not readily deposit scale.

Note that the hardness removed by the lime results in a decrease in total dissolved solids in the water. Use of soda ash merely converts the solids from calcium or magnesium to a sodium form.

If a water happens to have a proper ratio of carbonate and noncarbonate hardness, caustic soda, NaOH, may take the place of both lime and soda. Other waters that have considerable sodium contents, so their total alkalinity is greater than their total hardness, require the use of calcium sulfate, $CaSO_4$, to remove the sodium carbonate formed by the reaction of sodium bicarbonate and lime.

Make some provision for settling and coagulating or filtering the precipitated solids. The calcium carbonate is heavy and rather crystalline in nature; the magnesium hydroxide is gelatinous and thus helps to coagulate the finer precipitated particles. In fact, it also helps to remove silica from the water.

If insufficient magnesium is present, iron or manganese, which are also precipitated when CO_2 is removed by the action of lime, may act as coagulants. Recirculation of softener sludge is also helpful and in certain cases addition of magnesium oxide, sodium aluminate or some iron salt may be necessary to help coagulation.

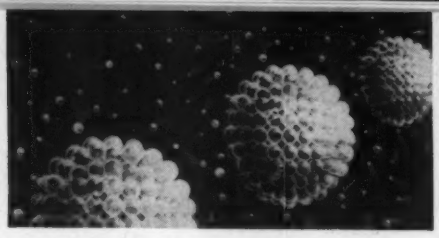
Softener types. Softeners may be either batch or continuous type and may take a number of different forms. Usually the water, chemicals and coagulants are well mixed and agitated, then either allowed to settle or passed upward continuously through a sludge blanket that acts as a filter. The sludge is usually blown down intermittently.

Pressure filters are employed following most batch softeners. They may also be advisable after the continuous sludge - recirculating type, although these usually produce a water with lower turbidity.

If water quantity or raw-water quality is subject to change, you need frequent testing to get complete softening without wasting chemicals.

In the sludge-type recirculating softener, the agitation speed and height of the sludge blanket may have to be regulated frequently to compensate for changes in water characteristics, temperature or flow rate. You may have to try out various methods of admitting water and withdrawing effluent

(*Continued on page* 200)



Up to this point we've looked at all angles of making power from uranium and thorium: physics of nuclear particles, reactor types, new forms of pumps, boilers and heat exchangers, auxiliary apparatus, controls. Now . . .

Let's design a nuclear power plant

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► WHILE WE HAVE EMPHASIZED the solid-fuel-type reactor, much of the design material applies equally well to the liquid-fuel-type reactor. Once the corrosion problems of the latter have been solved it will probably find wide acceptance for power generation.

Design method. To bundle up all the factors we've talked about so far we will lay out a design for a nuclear power plant in these last two articles. Let's choose a plant using a graphite-moderated liquid-metal-cooled thermal-type reactor.

Fig. 1 gives the heat-balance diagram for the plant using the following equipment and layout:

Two-coolant system—Secondary coolant loop between primary loop and steam loop eliminates possibility of accidental chemical reaction between *radio-active* sodium and water. This minimizes the containment, plant location, safety and exclusion-area problems. The secondary loop avoids the possibility of sodium hydride or hydroxide from a Na-water reaction entering the reactor and contributing to the neutron moderating effect of the graphite.

Coolant fluids—Both primary and secondary coolants are sodium.

Coolant loops—Each coolant system, primary and secondary, has four loops.

Coolant pumps—Each coolant loop has a reverse-flow ac electromagnetic-type liquid-metal pump; the eight loops need a total of eight pumps.

IHX units—Intermediate heat exchangers transfer energy from primary-coolant to secondary-coolant loops. Four sets of loops need four IHX units. Secondary coolant flows through tubes and primary coolant through the shell of these shell-and-tube exchangers.

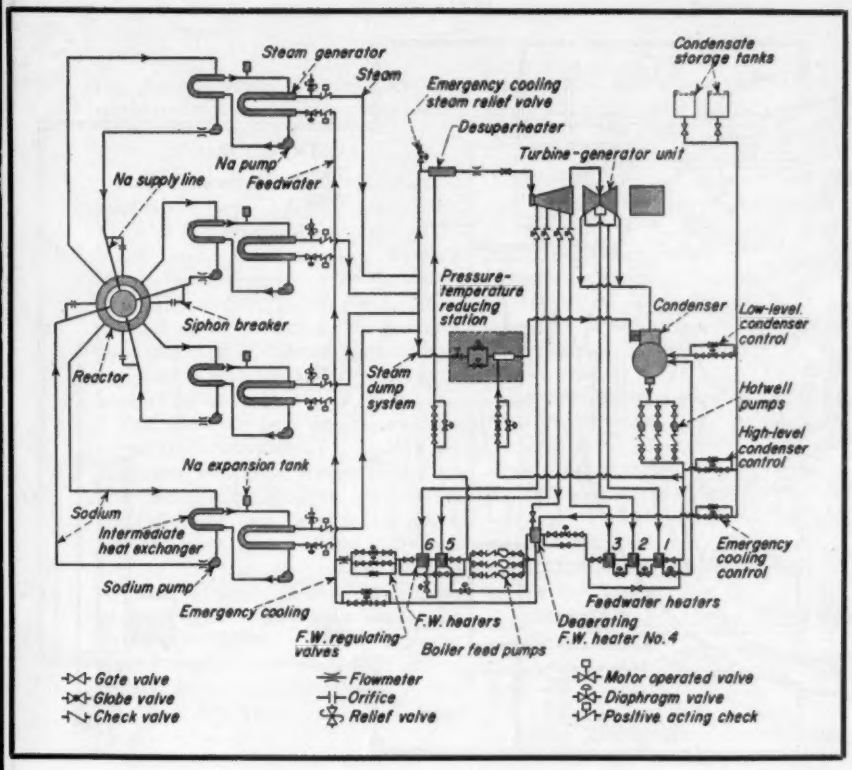
Boilers — These shell-and-tube exchangers have single-tube walls in a once-through arrangement. Water and steam flow through the tubes and the secondary-coolant liquid sodium through the shell. A total of four boilers receive their heat from the reactor. The hairpin or U-tube design of the boilers takes care of expansion. For more information on this type boiler see ASME paper No. 55-A-189.

Turbine-generator—Steam generated by the boilers is used in a tandem-compound triple-exhaust-flow 3600-rpm unit to generate electricity.

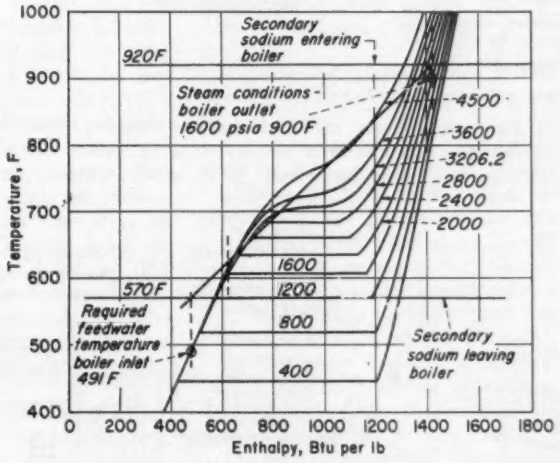
Feedwater heaters — Standard-type closed heaters with drain-cooling sections and one deaerating heater perform their usual duties.

Decay-heat removal—When complete loss of pumping power scrams a reactor the decay heat must be removed by natural circulation of the primary and secondary coolants. The coolants give up the decay heat to the boilers, which vent steam to atmosphere. Feedwater for the vented steam would come from the deaerating-heater storage tank through a bypass around the boiler feed pumps, feedwater regulator valves and feedwater heaters.

Steam-dump system—A full-capacity steam-dump and desuperheating system must bypass the turbine and dump steam to the condenser during load transients, and equipment or system



1 Sodium-cooled graphite-moderated 500-mw-heat reactor plant uses four coolant loops. Tandem-compound double-flow steam turbine feeds six heaters



2 Plotting sodium temperature-drop line on steam-water temperature-enthalpy diagram helps check the steam and water conditions used in plant cycle

failures. This system can be used during plant starting and shutting down.

Component ratings. Let's design our plant for the following levels:

Reactor power rating—500 mw, heat

Primary-coolant temperatures,

Leaving reactor	950 F
Entering reactor	600 F
Rise through reactor	350 F

Secondary-coolant temperatures,

Leaving IHX unit	920 F
Entering IHX unit	570 F
Rise through IHX	350 F

Assuming a 20-F difference between secondary coolant entering boiler and steam leaving the boiler and a 20-F difference between sodium leaving evaporator section of boiler and the saturation temperature of steam at boiler pressure we have:

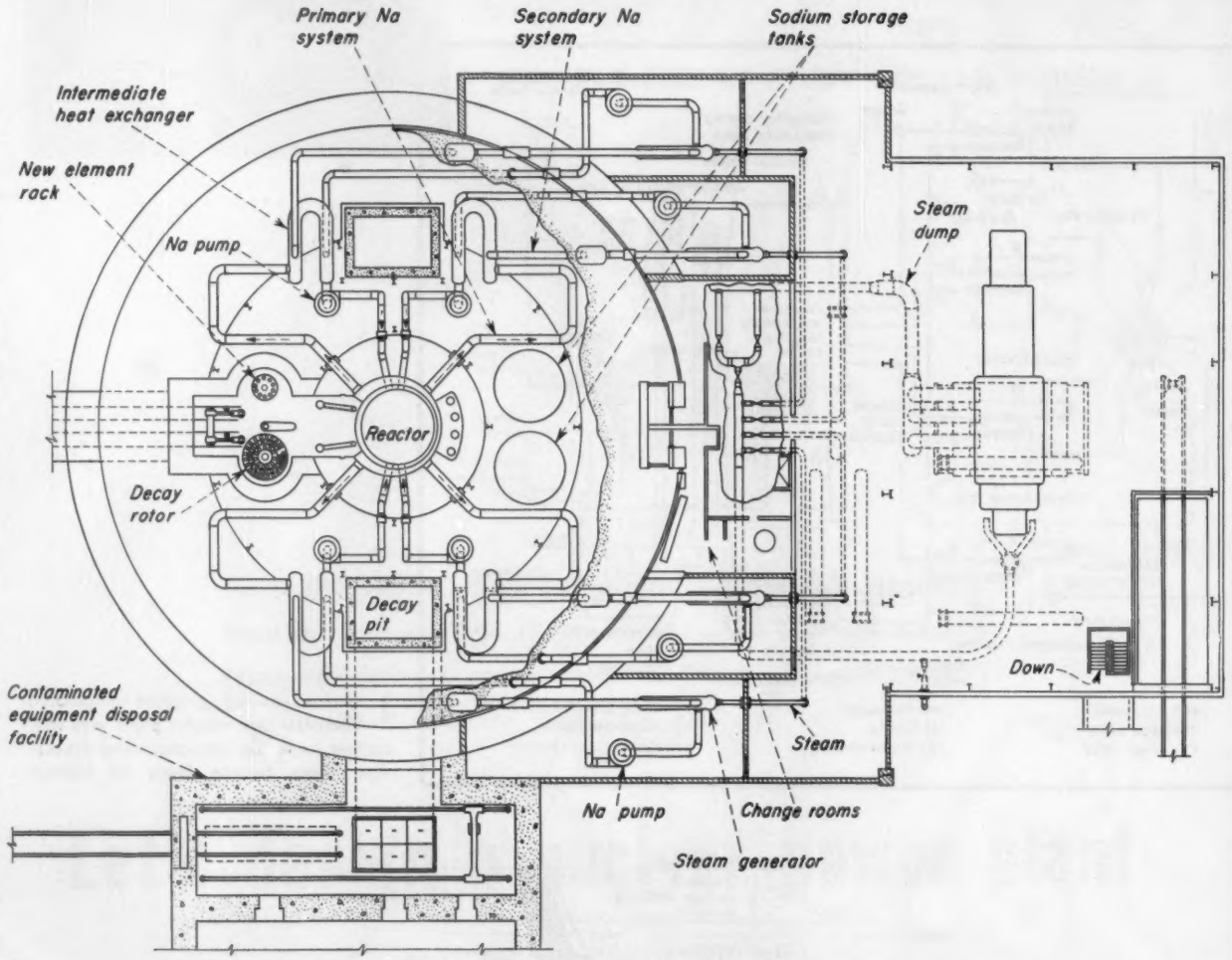
Boiler-outlet pressure	1600-psia
Boiler-outlet temperature	900 F

Feedwater temperature entering boiler we take at 491 F. Part No. 10, POWER, May 1955, outlined the method of determining the steam conditions for a nuclear plant. Fig. 2 shows a temperature-enthalpy diagram for water-steam with the secondary-coolant sodium temperature data superposed. The reactor coolant temperatures fix the steam and water conditions that can be used in the plant.

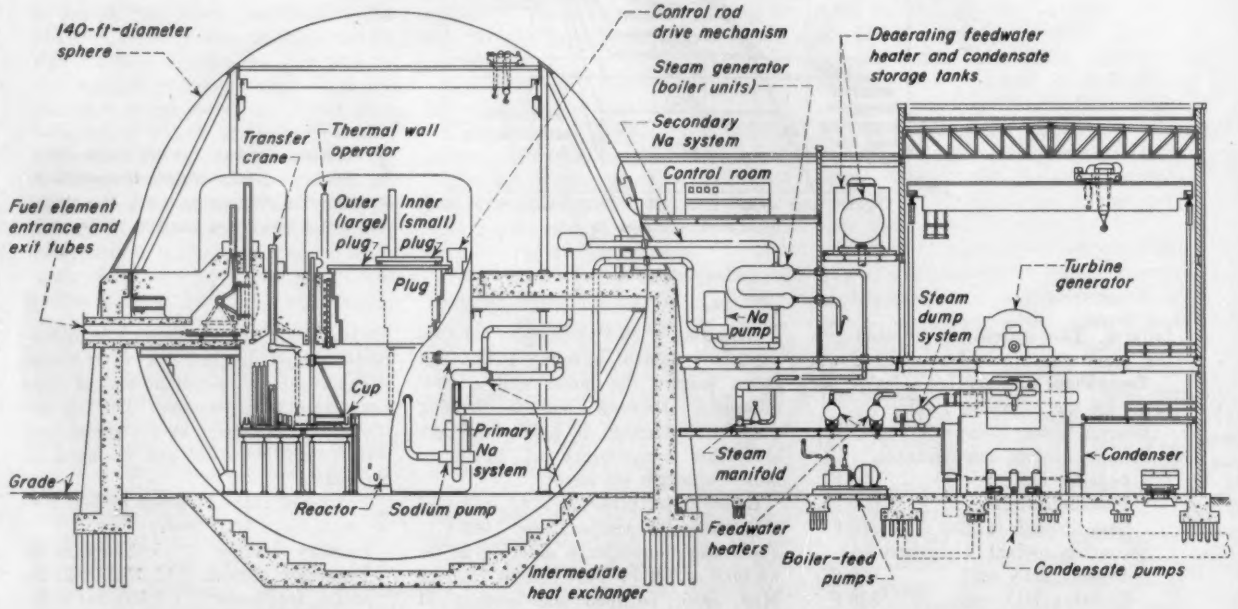
For rated reactor output of 500 mw we must have total flows:

Primary sodium	15,920,000 lb/hr
Secondary sodium	15,920,000 lb/hr
Steam, feedwater	1,805,000 lb/hr

(Turn page)



2 Intermediate heat exchangers cluster about reactor and remotely controlled fuel-handling equipment. Because IHX units handle radioactive sodium from the reactor they are placed inside 140-ft-dia containment sphere, behind concrete walls



4 Once-through steam generators stand outside of containment shell, producing 900-F 1600-psia steam for main turbine. Steam-dump system bypasses turbine to discharge steam directly to main condenser on sudden station-load drops, starting

Fig. 3 and 4 show plan and elevation sections of the total nuclear-power plant.

REACTOR DETAILS

Fuel elements of the reactor contain fissionable and alloying materials. U-235 is the fissionable material while U-238 and zirconium are alloying agents. All fuel elements are zirconium clad. The cladding confines the fission-product gases, minimizes corrosion and mass transport of the fuel material and improves its stability under exposure to nuclear radiation.

Fuel elements have special end devices. On the upper end a latching arrangement engages a mating pickup on the fuel-element-handling equipment. On the lower end an engaging piece locks the element in position at the bottom of the reactor vessel's internal structure. This holds the fuel element in place against the upward hydraulic thrust of the sodium upflow through the reactor core. The fuel-handling equipment must position the element in the core and then rotate it to lock it in place.

Moderator. Graphite acts as the neutron moderator in our reactor. Stainless steel—type 304—clads the graphite elements, preventing contact with the sodium. Sodium attacking graphite forms sodium carbide that can plug small coolant passages and colder sections of the coolant system. This attack also destroys the moderating effectiveness of the graphite.

Coolant flow. The primary sodium flows into an inlet plenum chamber at the reactor bottom and then flows up through the core. Fissioning of the U-235 and some of the U-238 and Pu-239 produces heat picked up by the sodium. The graphite moderator also produces a small amount of heat in thermalizing (slowing down) the fission neutrons.

Plug. A double-rotating plug arrangement above the sodium pool covering the reactor core: (1) houses and positions fuel-handling equipment (2) protects operators from nuclear radiations. The small inner plug carries the fuel-handling equipment. The large outer plug must be rotated, together with the inner plug, to position the handling apparatus.

Reactor vessel actually consists of two vessels: primary and secondary. The primary vessel holds the reactor core, coolant plenum chamber and flow passages, fertile material, graphite moderator, control equipment and accessory instrumentation. The primary vessel has an upper part holding a large pool of sodium. This keeps the reactor core flooded and the fuel elements submerged even during refueling operations. The pool of sodium helps to establish natural circulation through the reactor core and primary coolant loop when power supply to the e-m pump fails.

The secondary vessel acts as containment or backup for the primary vessel. If the latter should leak, the secondary vessel prevents the sodium from draining out and uncovering the reactor core.

Fuel-handling equipment does several jobs: (1) Removes spent fuel elements from the core. (2) Adds new fuel elements. (3) Carries new elements to the core and spent elements from the core. (4) Locks and unlocks fuel elements in the core.

Here's how we would go about refueling the reactor:

1. Shut down the reactor in normal procedure.
2. Lock the control rods into the reactor core for maximum insertion.
3. Check sodium level in upper pool to insure keeping fuel elements submerged during refueling operation.
4. Rotate outer and inner plugs as needed to position handling tube and pickup device over proper fuel element. An indexing control system does this job.
5. Lower the pickup device to lock with the attachment on top of the fuel element.
6. Unlock fuel element from bottom plate by turning; lift it out of core.
7. Rotate plugs to deposit spent fuel element into the proper transfer slot.
8. Rotate large plug about five degrees to pick up fresh fuel element from fresh-fuel-element transfer slot.
9. Rotate plugs to bring fresh fuel element over vacant position in core.
10. Lower fuel element into core and lock it into bottom plate by twisting.
11. Unlatch pickup from top of fuel element and withdraw from core.
12. Repeat steps 4 to 11 for each fuel element to be replaced.

Fuel-element storage. Spent fuel elements in the transfer slot rotate to a spot under the transfer crane. The crane picks up the element and deposits it in the storage rack submerged in the sodium. The sodium removes the heat energy generated during radioactive decay. At the end of the initial decay period (several months) the transfer crane moves the fuel elements from the rack to a slot under the exit transfer device. This device lifts the element out of the sodium and places it in a horizontal position on a dolly. The dolly moves the spent fuel element from the reactor building to the nuclear-fuel shipping building.

A movable baffle or separation wall isolates the sodium pool from the decay storage area during normal reactor operation. This wall must be raised during refueling operations.

New fuel elements are brought into the transfer crane by the dolly and handled in reverse order of that used for spent fuel. Fresh fuel, of course, is not stored in the storage racks, but immediately placed in the core.

Materials. Main-coolant-system parts touching sodium liquid or vapor in the loop or reactor are of stainless steel, 304 or 347, as needed. The exception is the zirconium cladding of the fuel elements. All other material touching sodium as in the unloading systems, transfer systems, storage tanks, fuel-handling equipment, decay storage, are of low-alloy ferritic type.

The stringent requirements and limited experience with reactor main sodium systems dictates using stainless steels. It should be feasible, however, to use low-alloy ferritic materials for all other equipment handling liquid sodium.

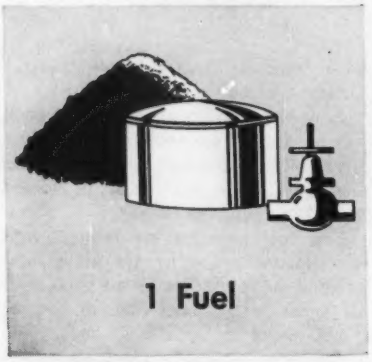
Reactor building. A 140-ft-diameter spherical building encloses the reactor and associated radioactive equipment. Design of the building must consider four primary factors: (1) containment of radioactive gases and vapors from a reactor accident (2) physical arrangement of equipment from erection and accessibility standpoints (3) radiation shielding needs (4) requirements of existing and future Codes. Physical arrangement must also allow for installing, testing, repairing, removing and replacing equipment with due regard for radiation hazards.

The next and final article will cover more design aspects and the general economics of this nuclear plant—in a forthcoming issue.

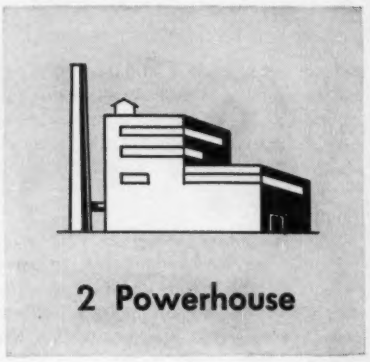
Reserve your copy now

Huge demand for reprints of *Nuclear Energy Study Courses* has firmed up plans to make it available as a book.

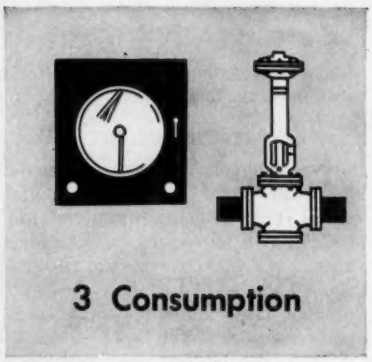
McGraw-Hill Book Company will publish—have it for sale by late 1956 or early 1957.



1 Fuel



2 Powerhouse



3 Consumption

4-point program for power-service economy

► THE BEST FUEL, a modern well-run powerhouse, controlled consumption, and enlightened administration not only improve the power services but also increase overall company profits.

This 2-part report tells how to achieve economy in each of these fields. Part 1 discusses fuel and powerhouse economy. Part 2, in an early issue, will take up savings in consumption and administration.

FUEL ECONOMY

Start the economy program by reviewing fuel. It's a major cost factor.

To check whether you are getting the most attractive rate, consider the type of fuel. Coal, gas, oil and sometimes wood or chemical byproducts are most frequently used. Compare costs per million Btu. Calculate this from approximate heat contents in Table 1, facing page, and delivered prices from local suppliers.

Other things to evaluate are available fuel supplies, contract terms, handling and firing conditions.

Availability may override any moderate differential savings. For example, local coal inventories may be consistent, while oil storage fluctuates during the year. On the other hand, if there are only one or two major bulk coal suppliers in the area, you may want the independence of selecting one of several oil suppliers.

Fuel contracts must be examined. Attractive gas rates are frequently tied to an interruption clause that restricts use during periods of high system load. This requires duplicate fuel systems at extra cost. But dual-fuel systems are good insurance for continued operation. Large consumers might well consider this a worthwhile investment. In any case, the question is whether the benefits are worth the cost.

Handling and firing conditions often influence operator preference for a fuel. Coal requires storage fields, crushing and sizing equipment, bunkers, stokers or burners, grates, ash-handling equipment. A large consumer in an area where coal is plentiful can justify this additional cost if the cheaper fuel rate will amortize it. Fuel oil requires storage tanks, pumps, heaters, piping and burners. Gas requires only minimum piping and burners; the supplier stores it.

The amount of handling required adds some additional operation and labor expenses to the cost of firing bulk oil and coal.

Another point to consider in choosing a fuel is the fact that gas burns the cleanest, followed by oils and coal.

Fuel conversion. If you discover that you are not burning the least expensive fuel, you may contemplate conversion. Evaluate the following points:

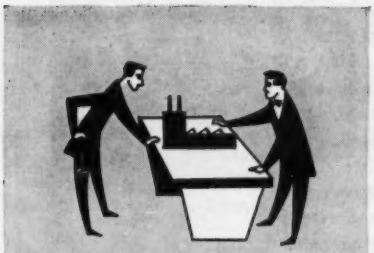
1. Changing from a liquid or gas to a solid fuel or vice versa is often expensive. Only considerable anticipated savings justify this. Conversion from liquid to solid fuel is particularly expensive. It requires completely new storage, handling and furnace arrangements; changeover costs are high. On the other hand, it is not too difficult to interchange liquid and gas within the furnace.

2. Conversion from one solid to another, one liquid to another, etc, is much less costly. For example, there are six Commercial Standard Classifications for fuel oil. Each heavier grade costs less, but requires some additional equipment to insure proper handling. See Table 2 on facing page.

Weigh the additional cost against the ability to amortize in a reasonable period. Sometimes a 4-year amortization is acceptable, but often one or two years is more reasonable.

Heavy oil is often recommended for large consumption. It requires reasonably careful operation, but fires well. Commercial oil is moderately priced and frequently recommended for small plants with light attendance. Diesel oil costs considerably more than commercial; use it only on very small unattended units. Stove oil burns economically only in small self-contained furnaces.

Oil burners fall into two categories: light and heavy. Light burners general-



4 Administration

PART 1 OF 2-PART REPORT

By **ALMONT KOEPF,**
Product development engineer
Kaiser Aluminum & Chemical Sales Corp

1: Heat content of common fuels

Fuel	*Purchase unit*	*Approximate heat content per unit*
Coal	Ton (2000 lb)	9000-14,000 Btu/lb
Oil, light (diesel)	Gallon	140,000 Btu/gal
Oil, commercial	Bbl (42 gal)	153,000 Btu/gal
Oil, heavy (or Bunker C)	Bbl (42 gal)	155,000 Btu/gal
Gas, natural	Unit or cu ft	10,000 Btu/unit
Gas, manufactured	Unit or cu ft	10,000 Btu/unit
Wood		Check locally

2: Fuel-oil firing characteristics

Type	*Commercial standard grade*	*Firing characteristics*
Stove	1	Very volatile. Used in pot or small pressure burners only
Diesel	2	Very easily pumped. Used in small pressure burners; requires no preheat; can be ignited electrically by transformers
Commercial	3	Easily pumped. Requires preheat for combustion. Should have automatic pilot or remote manual ignition
Heavy and bunker	5 & 6	Requires heating for pumping. Requires preheat for combustion. Must have automatic pilot or remote manual ignition. Soot blowers highly recommended in large units

ly take care of stove and diesel oils; heavy ones burn commercial or heavier grades. Some heavy burners operate marginally on bunker C.

Converting from diesel to heavy oil must include cost of a new burner.

For instance, suppose a plant burns 10,000 bbl of commercial oil per year and could save $0.60 per bbl by converting to bunker C. If rework involving burner, pumping, heating, ignition and storage required a capital expenditure of $5000, savings would pay for the new equipment in about 10 months. After that, the plant would save $6000 a year.

Coal furnishes the same attractive conversion possibilities. Using a less expensive grade without major equipment change produces savings. Installing crushing plant, powder units, improved stokers or ash-reclaiming systems considerably improve the overall performance at nominal cost.

Gas-oil conversions are common, especially where the consumer fires on an interruption-rate contract. Oil is burned whenever it becomes cheaper or when gas is not available. Gas-oil conversion can be included in new burners at a fraction of their total cost.

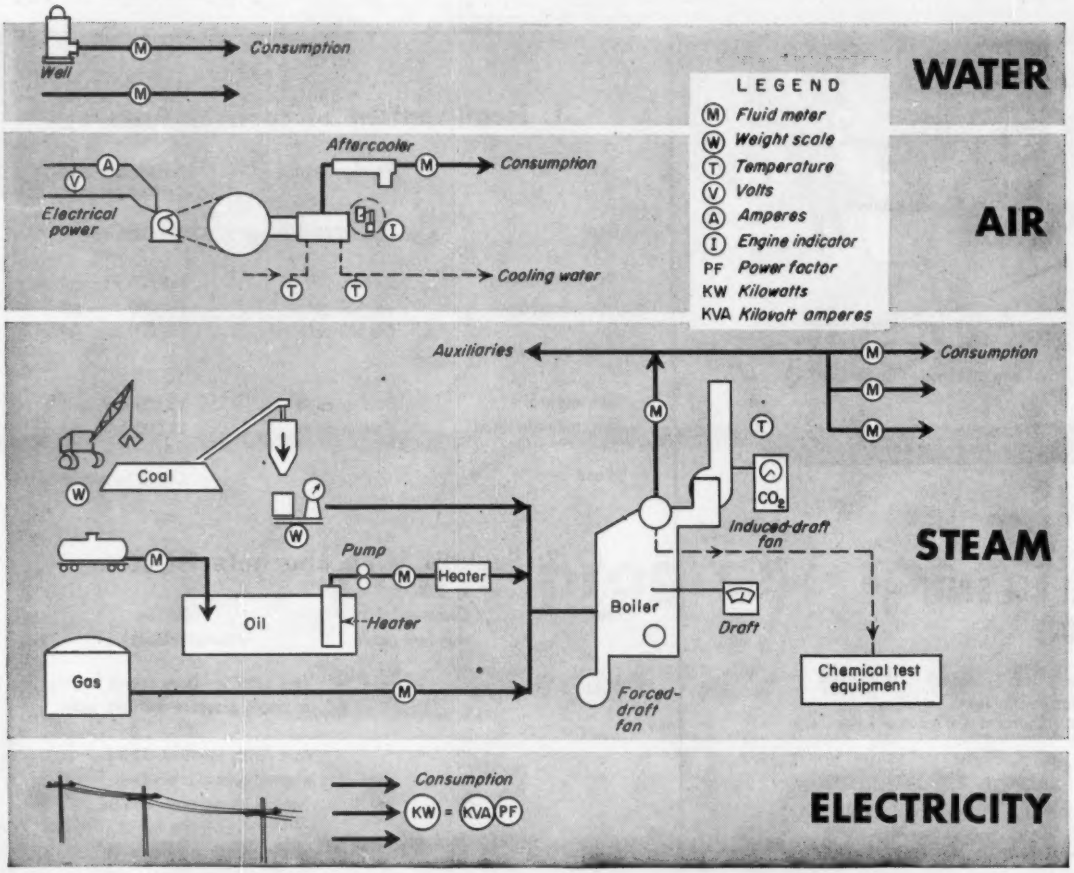
Deliveries. The final check point in fuel cost is the metering. Check delivered quantities to insure accuracy. Liquid and gas fuels are metered volumetrically. Convert delivered quantities back to an equivalent standard for accurate measurement. For example, fuel oils are corrected for billing at a 60 F standard temperature. Record fuel temperature at time of delivery, as well as the quantity shown by the meter reading.

Occasionally, check that all meters are in accurate working order. Test at shutoff or against known flow. Heavy-oil meters may develop slippage or inaccuracy. They can be rough-checked on the job by measuring the depth of oil stored in the bulk-storage tank.

POWERHOUSE ECONOMY

For good powerhouse operation, consider performance, condition, instrumentation, operating logs and purchased utilities like water, electricity.

Equipment performance must be at maximum values to realize full value from your dollar input. You have to evaluate each component of the power system to develop and maintain the



Check your plant instruments against these minimums

Instruments shown here are the minimum required for good power-plant operation. A more complete system would indicate all principal flows, pressures, temperatures and other factors necessary for determining the plant efficiency

best working output. Here are some of the items to consider:

For a normal industrial boiler, efficiency should be 75 to 82%. This is a function of stack temperature and percent CO_2 in the stack gas. It should be determined regularly.

Feedwater must have certain chemical characteristics to prevent system corrosion.

The general requirements are to (1) eliminate calcium, magnesium, iron and silica by precipitation, thus preventing scale, poor heat transfer, overheating and rupture (2) eliminate the dissolved-oxygen and carbon-dioxide gases by deaeration, thus preventing corrosion in the condensate-return system (3) remove settled mud and precipitates and surface frothing by intermittent and continuous blowdowns (4) maintain a basic solution of pH 9 to 11 to prevent formation of excessive acid ions and the consequent corrosion.

For a fast summary of common water-treatment methods, see Table 3 on the facing page.

Condition of plant and equipment is often vastly underrated. Management may feel that power services are a necessary evil to siphon off potential profits, and thus spend as little on them as absolutely necessary. Such an attitude causes high long-term operating costs (see "New Profit Opportunities in the Power Services," POWER, December 1954).

Plant equipment has progressed steadily to better performance during the last 50 years. Yet many plants are using major equipment 20 years old or older. Most of this equipment, particularly in smaller plants, cannot operate as efficiently as newer equipment. It will pay to check whether a new installation could be amortized rapidly.

For example, consider an old boiler that burns 20,000 bbl of oil at 67% efficiency. The oil costs $2.80 a bbl. A new boiler costing $15,000 could be substituted. If it fires at 77% efficiency, 10% of the fuel costs, or $5600 a year, is saved. Boiler is amortized in less than three years and profits increase $5600 a year thereafter.

Instrumentation is an absolute requirement for determining plant performance, checking on costs, and detecting malfunctions.

A complete instrumentation system can indicate all principal flows, pressures, temperatures and other factors necessary for determining efficiency. The degree of instrumentation naturally depends on the size of the plant, but there are certain minimums for good operation. See sketch, above.

Specifically, minimum efficiency-indicating instruments in a larger plant

3: Common methods of water treatment

Problem and its effect	*Chemical cause*	*Principle of the cure*	*Powerhouse practice*
Water hardness . . . produces scale; overheat and reduced heat transfer result	Calcium Magnesium Iron Silica	Soften by chemical interchange, causing flocculated precipitation and settlement. This increases soluble sodium content (see sodium salts)	*Internal treatment:* phosphates *External treatment:* lime-soda, zeolites, demineralization
Acids . . . produce excessive corrosion	Chlorides Bicarbonates Sulfates	Increase pH to 9-11 by adding alkalies	Add sodium salts
Gases . . . increase acid content; corrosive	Carbon dioxide Oxygen Ammonia	Heat and deaerate or degasify before feeding the boiler	Treat water in deaerator, deaerating heater, degasifier
Sodium salts . . . cause frothing on surface of water, increasing carryover	Sodium -bicarbonate -carbonate -hydroxide -chloride	Blowdown the concentrated salt solution	Continuous blowdown
Mud . . . causes scale, sludge, carryover in boiler	Mud Silt Sewage	Remove by settlement or filtration	Remove before water enters powerhouse
Oil . . . coats surfaces, causes overheating	Oil Grease Fats	Remove by coagulation or filtration	Remove before water enters powerhouse

should include: (1) for boilers, stack temperature, percent CO_2, oil and steam flowmeters (2) for water treatment, chemical-analysis sets, O_2 and pH testers (3) for air compressors, engine indicators, air flowmeters, ammeters, voltmeters. In addition, pressure and temperature gages at all necessary points give invaluable information.

A good powerhouse is fully and neatly painted. Pipe is color coded and tagged; coding may be painted on at intervals, or entire pipe may be painted in code. Complete prints of the plant flow diagram are posted. There are ample spare parts and maintenance tools to avoid excessive breakdown and performance losses.

Working logs. A good working log serves as the company record of performance and attendance, provides a running record for the engineer to note his own performance progress and integrates the shifts. The log sheet may take any form that will meet needs in your plant; its complexity varies directly with plant size. For example, a large compressed air center may require extensive logs on compressor operation, while in a small plant it may be enough to record compressor operating time under "remarks" on the boiler room log.

There are certain basic requirements for all log sheets.

The time period is normally 24 hours per sheet. Don't let the size get over 11x17 in. even if you need multiple sheets. Accumulate information in logical groupings for boilers, auxiliaries, fuel, feedwater treatment, turbines, air compressors, remarks.

Boiler and auxiliaries section should include data on the following:

1. Hourly entries for stack temperature and % CO_2, plus a column for combustion efficiency, taken off prepared CO_2 and temperature-conversion chart.
2. Shift entries for flowmeter integrator readings.
3. Pressures and temperatures that are expected to stay constant.
4. Blowdown times.
5. Fuel-tank or stockpile quantity soundings.
6. Fuel deliveries.

The water-treatment section should include shift entries for chemicals added and water analyses.

Turbine-section hourly entries: steam, gland, lubricator and condenser water pressures and temperatures; eccentricity; bearing vibration; shell expansion; speed. Shift entries: flow integrators on power production.

Air-compressor-section hourly entries: critical cooling water, lubrication, air flows, pressures, temperatures, electrical consumption and running time. Don't overdo this, as compressors normally require minimum attendance.

Leave space for each shift's remarks. This is the place for comments on improper performance, special tests, instructions for following shifts, general observations, notes on official visits.

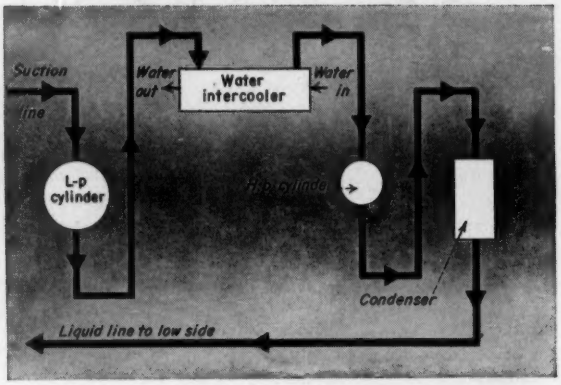
Do not force operators to record superfluous data; only note essentials. Record at least one variable in each composite system on an instrument to provide a continuous performance record to accompany the log sheets.

As a minimum, record items like boiler-stack temperature and CO_2, steam flow, turbine-generator output, turbine eccentricity, compressed-air flow or compressor electrical consumption and pressure.

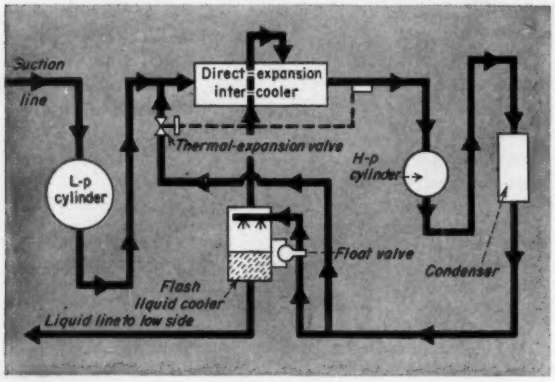
Water and electricity. Cut down water and electricity costs by periodically reviewing the local utilities' rate structures. If your firm was initially on a light commercial rate, and has expanded, you may be entitled to a lower rate. Check on this to avoid paying more than necessary.

Check water-supply sources. If raw-water supplies are close by, investigate dual domestic- and industrial-water system use. Consolidate meters wherever possible to reduce fixed charges.

Electrical rates are normally tied to peak (15-minute) demands and power factor. Holding peak electrical demands to a lower, smoother peak may help. One way to do this is by automatically cutting out nonessentials during peak time. Part-load demand, high capacitance or inductance loads increase power-factor penalties. Corrective equipment to return power factor to an attractive rate may be indicated.



1 Water intercooling using a shell-and-tube intercooler between the l-p and h-p cylinders of refrigerant compressor



4 Direct-expansion intercooler with a flash liquid cooler. Gas from the liquid cooler flows up to the intercooler

By O B WERT

Air Conditioning & Refrigeration Division
Worthington Corporation

Six methods for gas intercooling in

► MULTISTAGE compression refrigeration systems are necessary in many low-temperature cooling processes. We find them in a variety of government, commercial and industrial installations. Typical uses include testing of instruments and controls at low temperatures in government research centers and industrial plants, quick freezing and storage of foods and processing of chemicals. Use of gas intercoolers and liquid subcooling, which is common in most of these systems, gives a thermal improvement in the cycle.

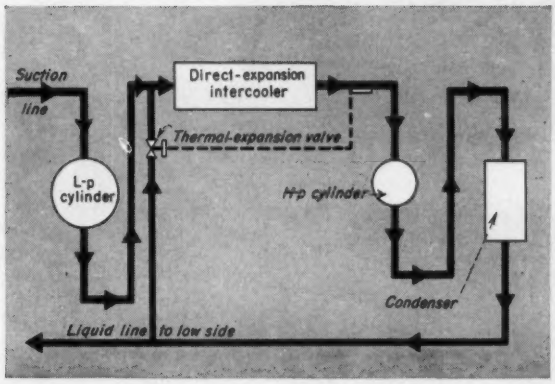
Intercooling is removal of heat from the refrigerant gas betweeen compression stages. Its main function is to keep the high-stage-cylinder gas discharge temperature within reasonable limits. This prevents overheating and breakdown of the cylinder lube oil. Heat is removed in intercooling by a heat exchanger using cold water or some other suitable fluid. Direct expansion of refrigerant into the gas discharged by the low-pressure cylinder is another method to produce intercooling.

Subcooling is removal of heat from the liquid refrigerant. This process lowers its temperature to a level below that corresponding to its condensing pressure. Cooling may be done by well water or other suitable fluid. But the most common procedure is direct expansion of the refrigerant in a cooler placed between the compressor stages.

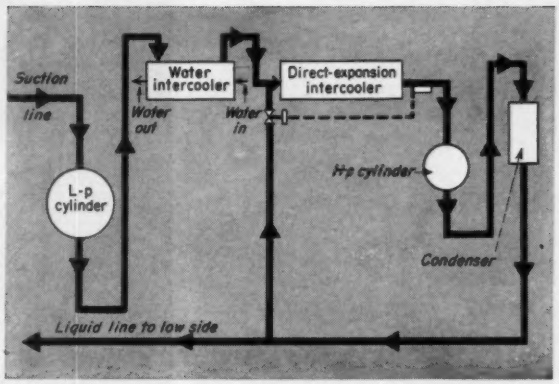
In subcooling by direct expansion, the refrigerant expanded has as its evaporator or suction pressure the high-stage-cylinder suction pressure. This is called the intermediate pressure. The liquid refrigerant is subcooled to approximately the temperature corresponding to the intermediate pressure.

Subcooling is done to increase the refrigerating effect of the liquid at the low-temperature expansion valve. The additional refrigerating effect made available in each pound of liquid reduces the displacement or pumping capacity required of the low-stage cylinder. Since subcooling is done at a higher suction pressure (the intermediate pressure) a saving in power is obtained in compressing from the low-stage to the condensing pressure.

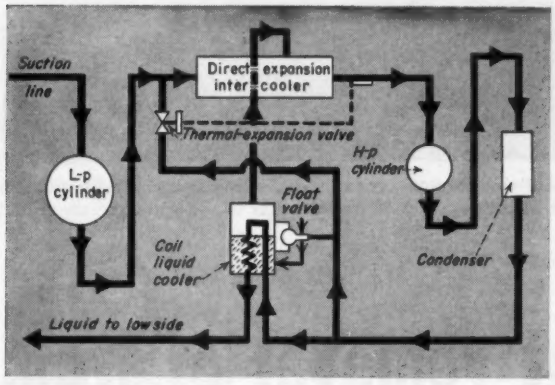
Large-capacity systems are often built multistage primarily to secure



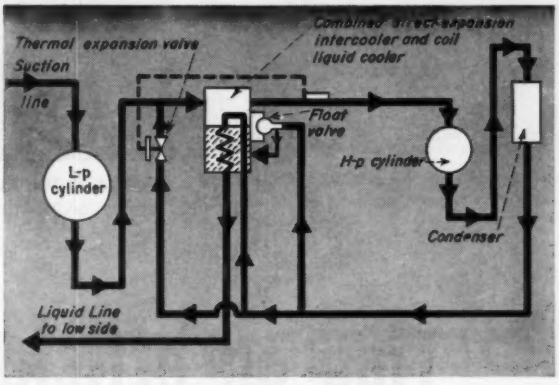
2 Direct-expansion intercooler between the l-p and h-p stages of the compressor has refrigerant fed by expansion valve



3 Combined water and direct-expansion intercooling, with the coolers arranged for series flow of the refrigerant gas



5 Direct-expansion intercooler used with coil liquid cooler. A float valve controls liquid flow into the cooler shell



6 Combined direct-expansion intercooler and a coil liquid cooler in a single vessel. This design reduces the costs

multistage refrigeration compressors

higher volumetric efficiency. These units do not need intercoolers. Use of two cylinders means a smaller compression ratio per cylinder, and smaller cylinder displacement because of the greater efficiency. The compressor can have a shorter stroke and higher rotative speed, resulting in a less expensive unit.

Drive motor, now almost universally the synchronous type for large reciprocating compressors, is also cheaper. No appreciable saving is obtained in the adiabatic horsepower required to compress the gas in these applications. Friction horsepower is less because the compressor frame and running gear are smaller. Net result is a somewhat lower connected horsepower at a cheaper initial cost.

Water intercooling, Fig. 1, requires an adequate supply of water at a suitable temperature. As shown, gas flows from the low-pressure (l-p) cylinder through the shell side of the heat exchanger on its way to the high-pressure (h-p) cylinder. Water flows through the tubes, single or multipass, depending on the amount of water available. Gas flow is baffled so the gas makes several passes over the tubes to improve heat transfer.

Lowest gas temperature that can reasonably be expected is 15 F higher than the entering water temperature. Where the process requires low suction temperatures, not much cooling of the gas occurs unless water between 35 and 50 F is available. Since a low suction temperature means that the gas discharged by the l-p cylinder is relatively cool, a study must be made to see if the cooling effect obtained is sufficient to compensate for the cooler cost.

Other systems are attractive in most plants, because of two major disadvantages of water intercooling—high water temperature met in most localities and the danger of ruptured tubes in the heat exchanger, caused by coolant freezing during careless startups.

Direct expansion, Fig. 2, permits using water intended for intercooling in the refrigerant condenser. This gives a lower condenser pressure, increasing the compressor capacity and reducing the required power input.

As Fig. 2 shows, gas discharged from the l-p cylinder enters an intercooler

(*Continued on page* 192)

IRON AND MANGANESE removal from acid well water using aeration, neutralization, settling and filtration. Capacity is 1.44 million gpd of 33-ppm-iron raw water

Tips on efficient removal of iron,

Here, in the second of two articles, an outstanding authority shows you the methods that are good for treating process water, how they stack up costwise, what performance to expect in your plant

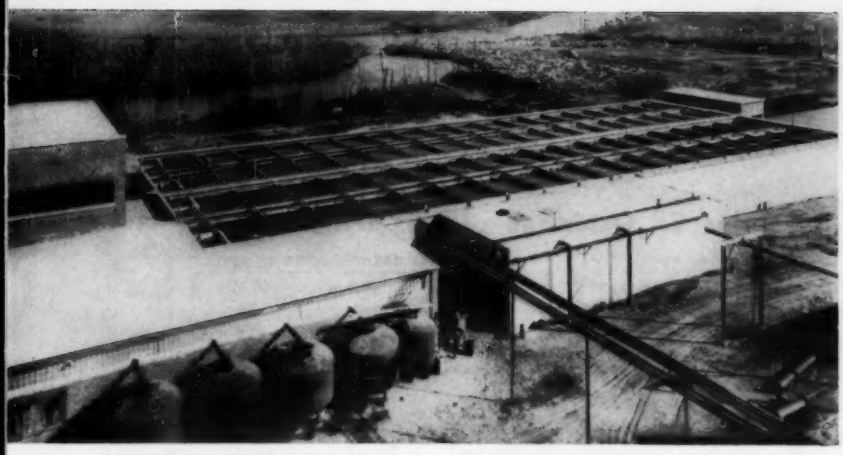
By ESKEL NORDELL
The Permutit Company

► WE DISCUSSED several methods of removing iron and manganese from process water in April POWER, pp 91-93. This month we continue the discussion and present five tables, p 102, showing the effect of various factors on iron and manganese.

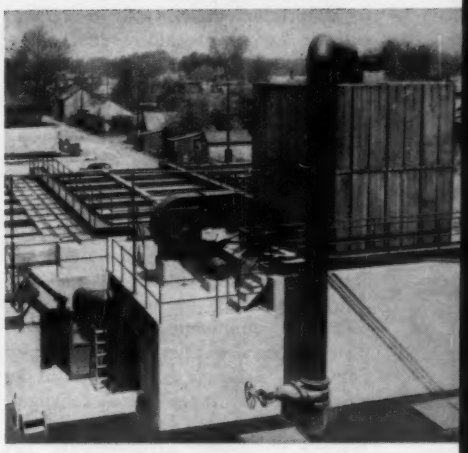
Reactions. Table 1 shows the effect of pH on the oxidation of ferrous iron by dissolved air. Table 2 shows that the oxidation of ferrous iron by chlorine may be effected at a much lower pH value than by dissolved air. Manganese is the subject of the next three tabulations. Table 3 shows the effect of pH on the oxidation of manganous manganese by dissolved air, without stirring. The catalytic effect of 1 gram per liter of previously aerated and precipitated manganic hydroxide, with stirring, on the oxidation of manganous manganese by dissolved air at various pH values is shown in Table 4. Lastly, Table 5 shows the effect of pH on the oxidation of manganous manganese by chlorine, without stirring.

Zeolite softening. The combination lime-zeolite water-softening process may remove iron and manganese by aerating the water before it enters the settling tank. The usual hookup consists of an aerator, settling tank, filters and zeolite (sodium-cation exchanger) units. If the amount of free carbon dioxide in the raw water is low, the aerator may be a simple one consisting of only two or three steps over which the water flows before dropping into the settling tank. But if the free carbon dioxide is high, a coke-tray aerator or a wood-slat tray aerator will lower the lime dosage appreciably.

In this process, lime alone is used in the first stage plus, if necessary, a small dosage of a coagulant. However, if the iron content is fairly high, it acts as a coagulant and no other may be needed. The reason for using lime alone in the settling tank is because bicarbonate hardness can be removed more cheaply by lime than by zeolite while noncarbonate hardness can be removed more cheaply by zeolite than by soda ash and lime. So the iron or manganese and the bulk of the bicarbonate hardness are removed in the cold-lime-process settling tank and filters. Then the filtered effluent is passed through the



COAGULATION AND SETTLING are used here to remove color and organic (chelated) iron from a high-color surface water. Capacity is 34.5 million gpd of raw water



COLD LIME SODA softener, degasifier to remove iron, manganese from water

manganese, color from process water

zeolite units, which remove both the residual bicarbonate hardness and the noncarbonate hardness. The final effluent is practically free from hardness (usually only ⅛ to 1/16 gpg). Capital costs for the combination lime-zeolite water-softening plant are obviously higher than for either plant alone. Operating costs on high bicarbonate hardness waters, however, are usually lower.

Exchange, demineralization. Either iron or manganese is readily removed, together with calcium, magnesium and sodium, in the hydrogen-cation exchanger. The exchanger used is either of the carbonaceous or resin type as the siliceous zeolites are unsuitable on the hydrogen cycle. In the sodium-cation-exchanger process, the regenerant is salt, and the softened water contains an equivalent amount of sodium salts, so the total solids content is not reduced.

In the hydrogen-cation-exchanger process, the iron or manganese, plus calcium, magnesium and sodium, is removed by the exchanger and replaced by an equivalent amount of hydrogen ions. The regenerant used is usually sulfuric acid, and in this process the bicarbonates are removed leaving only carbon dioxide in the water. Thus the total solids content of the effluent is reduced by an amount equivalent to the bicarbonate or alkalinity content of the raw water. The sulfates and chlorides, however, show up in the effluent as equivalent amounts of sulfuric and hydrochloric acids, and these must be neutralized before use. There are two methods of accomplishing this. One uses neutralization of the aerated or degasified effluent with caustic soda. The hookup for this usually consists of a hydrogen-cation exchanger, degasifier basin and alkali feeder.

The other method uses both hydrogen-cation-exchanger unit(s) and sodium-cation-exchanger unit(s), the flows being so proportioned that, when mixed, the sodium-bicarbonate content of the sodium-cation-exchanger effluent neutralizes the acidity of the hydrogen-cation-exchanger effluent and furnishes whatever degree of alkalinity is required. A typical installation of this type consists of a hydrogen-cation exchanger, a sodium-cation-exchanger and a degasifier to remove the carbon dioxide formed from the bicarbonates in the hydrogen-cation exchanger, plus that formed by neutralizing its acid effluent with the sodium-cation-exchanger effluent. This applies to the production of low-alkalinity effluents, free from hardness as well as iron or manganese but containing sodium sulfate and chloride equivalents to the amounts of sulfates and chlorides present in the raw water.

For certain processes, the water should be practically free from all mineral matter — equivalent to distilled water in quality. Such water can be produced by an ion-exchange demineralization process, and with most fresh waters, at a cost only a small fraction of the distillation costs. In this process, iron, manganese, calcium, magnesium and sodium are removed by a hydrogen cation exchanger while the acids formed are removed by an anion exchanger. If removal of silica and small amounts of carbon dioxide are not necessary, then a weakly basic anion exchanger, which will remove only the

strong acids, may be used. The hookup for this arrangement usually consists of a hydrogen-cation exchanger, weakly basic anion exchanger and degasifier. Weakly basic anion exchangers may be regenerated with a solution of soda ash. This removes the acids from the anion exchanger and converts it back to its original state, ready to remove sulfuric and hydrochloric acids from another equal quantity of the hydrogen-cation-exchanger effluent.

If an effluent free from silica and carbon dioxide as well as the strong acids is required, then a highly basic anion exchanger is employed. This type of anion exchanger is regenerated with a solution of caustic soda. Depending on the amounts of water to be treated, its composition and other requirements, any of several arrangements of equipment may be used: 2-step with degasifier, 2-step without degasifier, mixed-bed, 4-step with degasifier and hydrogen-cation-exchanger, and mixed bed with degasifier. Several typical equipment arrangements are shown on pp 100 and 101.

In the equipment arrangements where a degasifier is not included, the anion exchanger removes the carbon dioxide. This costs more than removal by aeration. But the simplicity of equipment may outweigh the higher operating cost if (1) bicarbonate content is relatively low or (2) amounts of water being handled are not large or (3) conditions in both (1) and (2) exist. The mixed bed demineralization unit is similar in operation to a battery consisting of an extremely large number of alternate hydrogen-cation and anion exchangers, and it produces an extremely high-grade effluent. A more economical arrangement, as far as operating costs are concerned, is the hydrogen-cation exchanger and mixed-bed with degasifier. The 4-step with degasifier is a practical hookup as, in its operation, the last two units in the battery (whose capacities have been used to only a very limited extent) carry the full load while the first two units are being regenerated. Then, after regeneration, the last two units in the battery become the first two on the next run.

Acid waters are found in many mines where sulfur-containing materials, notably pyrites, oxidize in the presence of air and water to form sulfuric acid and ferrous sulfate. These mine waters may drain into surface waters in such quantities that they may even make large rivers acid. Some wells and springs in the vicinity of mines may also have acid waters. Certain trade wastes may also acidify surface waters into which they are discharged. Occasionally they contaminate neighboring ground waters. Acid waters usually contain ferrous sulfate which in itself is acidic. In addition, they may contain free sulfuric acid, manganous and aluminum sulfate. As all are acidic, these acid waters are very corrosive, especially to bare or galvanized ferrous metal.

Iron or manganese, or both, may be removed from acid waters by one of three methods: (1) aeration, neutralization, settling and filtration, (2) cold-lime-soda water softening, (3) combination lime-zeolite water softening.

With a surface water low in free carbon dioxide and containing sufficient dissolved oxygen, aeration may often be omitted. Acid ground waters usually are deficient in dissolved oxygen and

(*Continued on page* 194)

Table 1: Effect of pH on iron oxidation

	Raw water	Iron in aerated and filtered water, ppm		
pH	Iron, ppm	15 min	30 min	60 min
5.0	10.0	9.0	—	7.5
5.5	10.0	5.5	4.6	4.0
5.95	10.0	5.0	4.0	3.5
6.15	10.0	4.4	3.5	2.5
6.5	10.0	2.8	1.8	0.3
6.65	10.0	0.7	0.2	0.1
6.8	10.0	0.2	0.1	<0.1
7.0	10.0	0.1	<0.1	<0.1
7.45	10.0	0.1	<0.1	<0.1
8.05	10.0	<0.1	<0.1	<0.1

Table 2: Oxidation of iron by chlorine

	Raw water	Iron in treated and filtered water, ppm		
pH	Iron, ppm	15 min	30 min	60 min
4.0	10.0	—	—	0.8
4.55	10.0	—	—	0.5
5.0	10.0	<0.1	<0.1	<0.1

Table 3: Oxidation of manganese

	Raw water	Manganese in aerated and filtered water, ppm		
pH	Manganese, ppm	15 min	30 min	60 min
8.5	10.0	—	—	10.0
9.0	10.0	—	—	9.0
9.3	10.0	8.5	8.0	7.5
9.5	10.0	7.5	5.0	3.2
9.7	10.0	3.0	1.3	0.9
9.95	10.0	0.9	0.7	0.6
10.3	10.0	<0.02	<0.02	<0.02

Table 4: Effect of catalyst on manganese

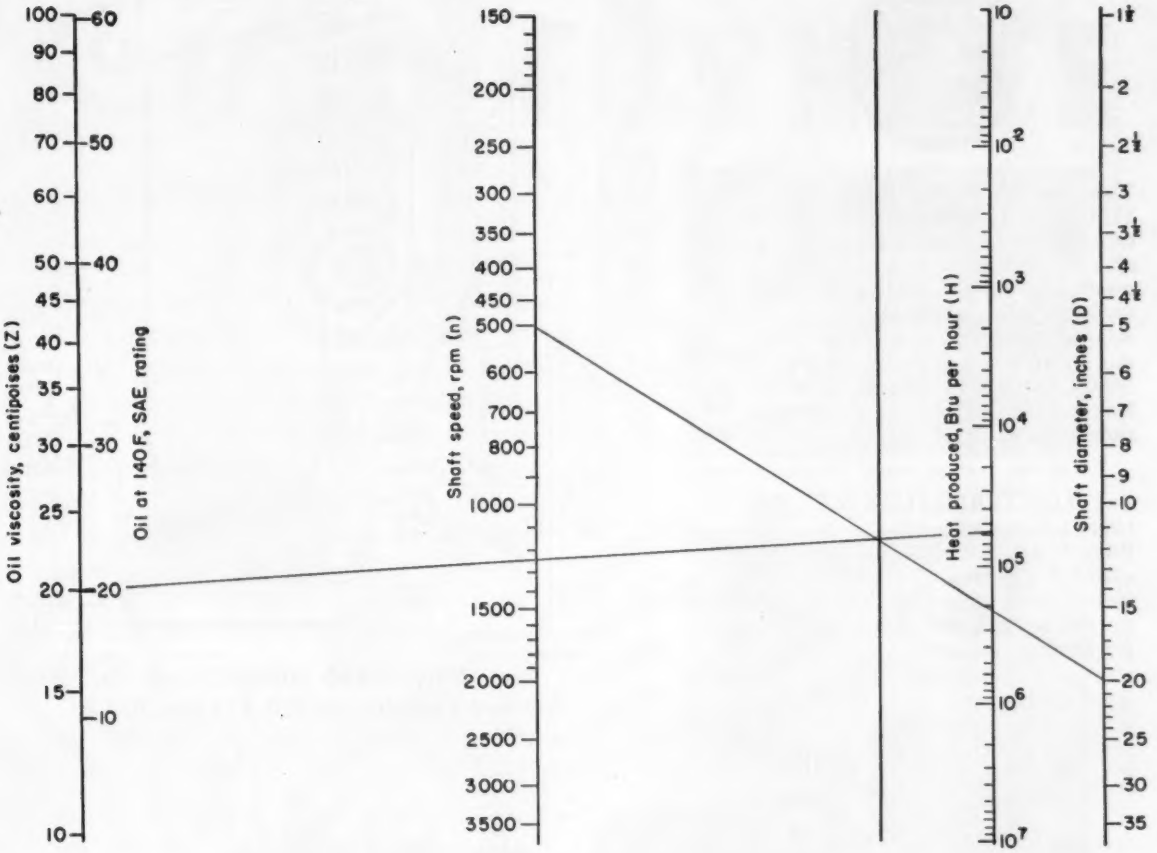
	Raw water + catalyst	Manganese in aerated and filtered water, ppm		
pH	Manganese, ppm	15 min	30 min	60 min
7.5	10.0	—	—	3.0
8.0	10.0	—	—	0.3
8.5	10.0	<0.1	<0.1	<0.1
9.0	10.0	<0.1	<0.1	<0.1

Table 5: Effect of pH on oxidation

	Raw water	Manganese in treated and filtered water, ppm		
pH	Manganese, ppm	15 min	30 min	60 min
8.05	10.0	—	—	9.0
9.0	10.0	8.0	6.5	5.0
9.45	10.0	4.5	2.5	1.3
10.0	10.0	0.3	0.1	<0.02

Power's DATA SHEET

No. 287



Energy loss in horizontal bearings

► THE CONVENTIONAL horizontal radial bearing, usually babbitt-lined, uses an oil film for lubrication. Newton's law of viscous flow may be applied to figure the energy loss by this equation:

$$H = (D^2Ln^2ZD/C)/1.04\text{x}10^9$$

where

H = energy loss, Btu per hr
D = shaft diameter, in.
L = effective bearing length, in.
n = shaft speed, rpm
Z = oil viscosity, centipoises
C = clearance = bore diameter – shaft diameter, in.

This formula applies only to bearings with speed high enough to establish an oil film around the shaft journal. This will be done when:

$$S_2 = Zn/p \geqq 50$$

S_2 = dimensionless bearing constant
p = bearing pressure on projected area, lb per sq in.

For S_2 less than 50 the fluid pressure produced in the film becomes too small to support the load, and so the film breaks. This causes boundary lubrication and metal-to-metal contact with greatly increased friction. This can be tolerated only for very slow and intermittent operation.

The nomogram above applies to bearings with $D/C = 1000$ and $L = 1.5D$. Most horizontal bearings for service in the power field have these ratios. The allowable oil-film temperature is 140 F. To simplify the chart the SAE ratings for lubricating oils at this temperature have been marked.

Example: Find the heat generated in the bearing of a 20-in. shaft that has a D/C of 1000 and $L = 1.5D$ when using No. 20 SAE oil. Bearing pressure is 200 psi.

From $S_2 = Zn/p = 20\text{x}500/200 = 50$, we know the chart applies. First, find shaft diameter 20 on right-hand scale and shaft speed 500 on second scale from left. Lay straightedge between two points to find intersection with blank index line. Then lay straightedge from this intersection to 20 on SAE scale and find answer on heat scale, 58,000 Btu per hr.

H W HAMM *York, Pa.*

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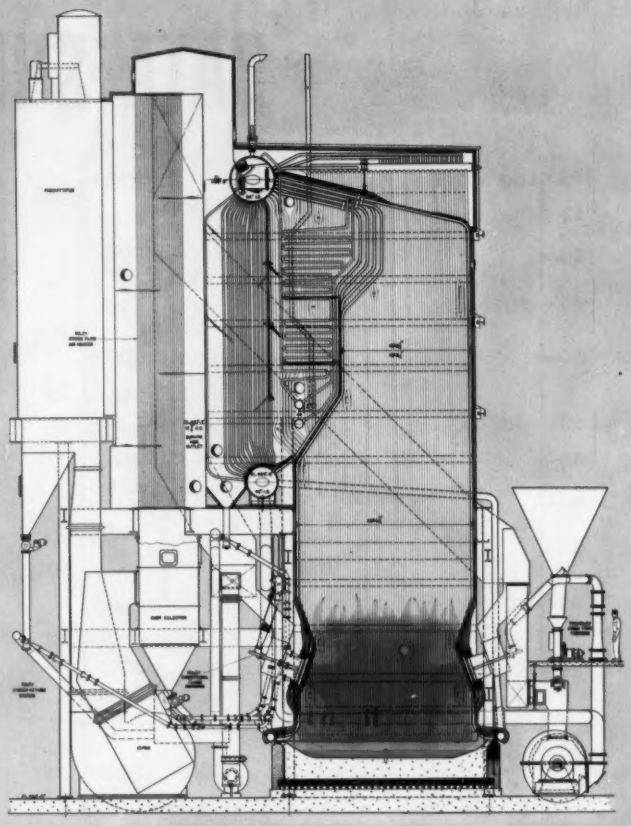
A 1955 POWER MODERNIZATION AWARD WINNER

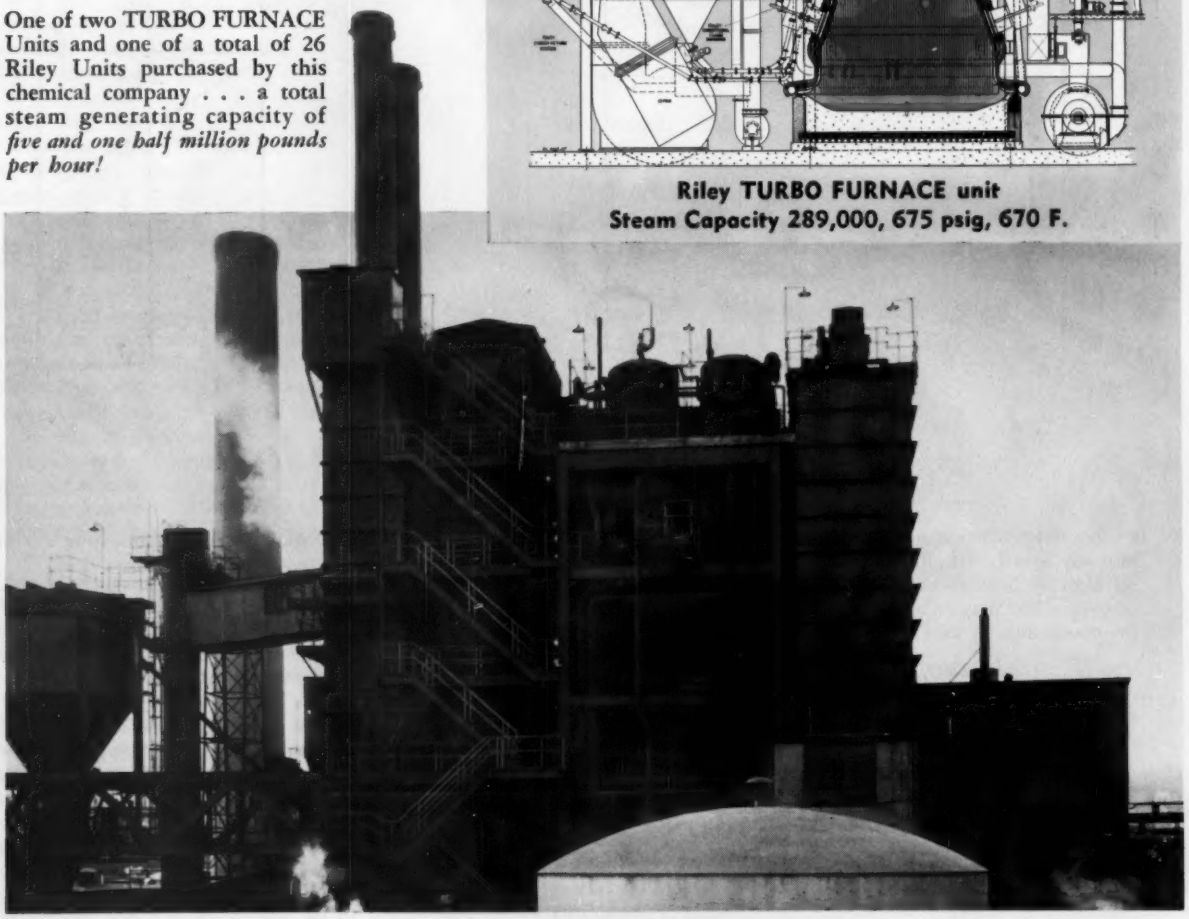
Power MODERNIZATION PROGRAM

This 289,000 lb./hr. Riley TURBO FURNACE Unit replaces several low capacity, low efficiency units and is part of a modernization program that has resulted in a total of $470,000 annual savings on the making of steam by the original boilers. A considerable part of this saving is due to the TURBO FURNACE Unit's high efficiency, low carbon loss in fuel, lower maintenance, elimination of flyash disposal problem.

One of two TURBO FURNACE Units and one of a total of 26 Riley Units purchased by this chemical company . . . a total steam generating capacity of *five and one half million pounds per hour!*



Riley TURBO FURNACE unit
Steam Capacity 289,000, 675 psig, 670 F.



A survey of your plant by a consulting engineer could show you ways of making surprising savings in your power costs.

TURNS FLYASH INTO PROFITS

for prominent West Virginia Chemical Company

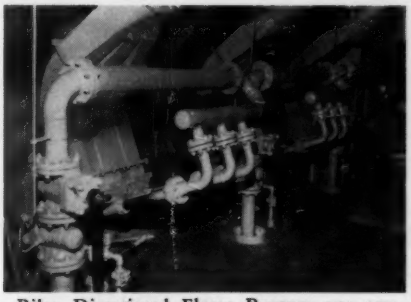
The *New* RILEY

TURBO FURNACE

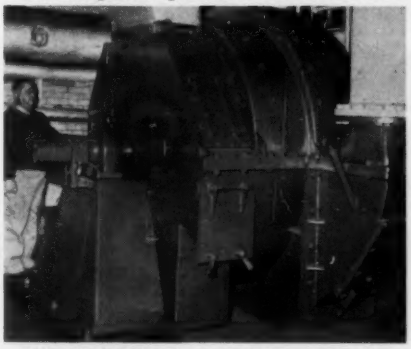
Once flyash disposal was a major problem fot this company. Today Riley TURBO FURNACE Units are helping to solve this problem. At Plant (A) flyash is reinjected into the TURBO FURNACE combustion zone where high heat concentration and extreme turbulence converts ash to slag; when tapped and cooled, slag is easily disposed of, resulting in a usable product and a substantial savings in net cost of plant operation. At Plant (B) another Riley TURBO FURNACE unit successfully burns its own flyash . . . and even flyash from an adjacent dry bottom unit.

. . . in addition to eliminating flyash disposal, the Riley TURBO FURNACE also offers users these advantages:

- **Will burn efficiently a wide range of coals, oil, gas, lignite, delayed coke, and fluid coke.**
- **Low carbon loss increases unit efficiencies, lowers fuel cost.**
- **Clean heating surfaces do away with slag blowers.**
- **No stratification of furnace gases.**
- **Furnace exit gas temperatures are the same regardless of fuel.**
- **No change in pressure parts needed when converting to solid fuels.**
- **One level burner operation.**
- **Higher heat release rates: lower overall height.**



Riley Directional Flame Burners use any fuel or combination of fuels; available with complete sequential automatic control.



Riley 550 Pulverizers with Tungsten Carbide faced grinding elements resist wear and reduce maintenance.

UNITS WITH RILEY TURBO FURNACES ARE DESIGNED FOR ANY CAPACITY, PRESSURE, TEMPERATURE

TURBO FURNACE Units have been purchased by *Delaware Power & Light Co.* — three 500,000 lbs./hr. units designed for firing fluid coke; *Texas Electrice Service Co.* — 825,000 lbs./hr. reheat unit designed for firing gas, oil and Texas lignite; *Louisiana Power & Light Co.* — one 1,550,000 lbs./hr. reheat unit designed for firing gas, oil, coal and fluid coke; *Kaiser Aluminum & Chemical Corp.* — two 320,000 lbs./hr. units for gas and oil, future coal.

Consult your Riley Representative in these cities for complete details about the Riley TURBO FURNACE.

Worcester, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

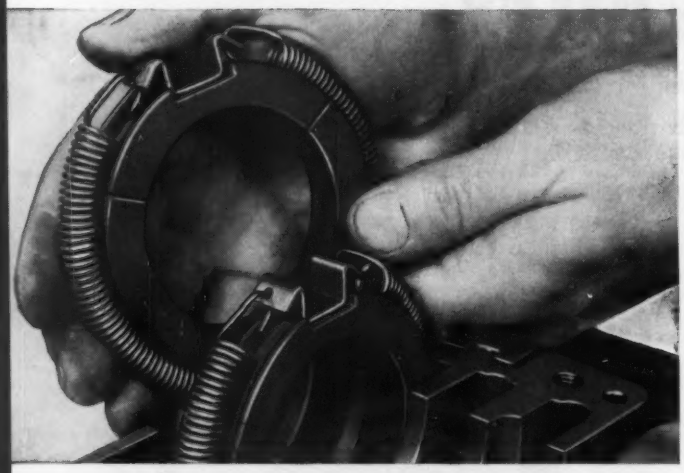
RILEY

Stoker Corporation

WORCESTER, MASSACHUSETTS

On all General Electric High-speed Turbines,

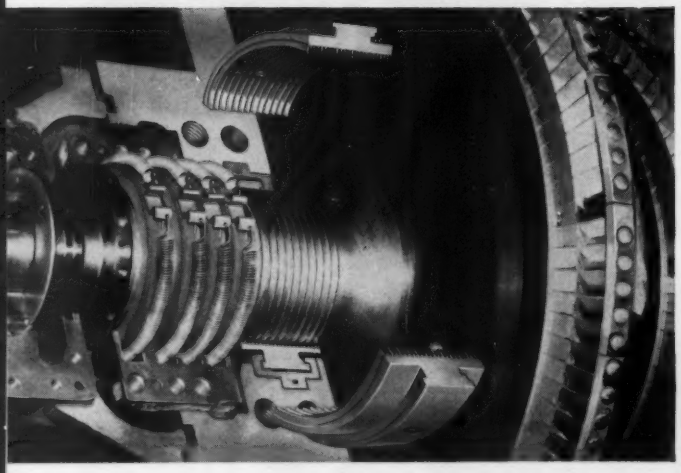
Well-designed, efficient seals...



Low-cost, easily-replaced carbon packings

For the most efficient shaft-end sealing, well-designed, low-cost carbon packings are used on G-E High-speed Turbines to seal steam pressures up to 75 psig. Made of non-galling, self-lubricating carbon-graphite, these segmental rings have high mechanical strength in the small sizes used, assuring long life under normal operating conditions. A garter spring in an offset "V" groove holds each ring together and presses it firmly against the side of the chamber, forming a tight seal. This unique arrangement permits the rings to support their own weight and to adjust themselves to the shaft position, thereby reducing wear and increasing the life of the seal. The rings are contained in compact external packing boxes, and can be easily inspected or replaced without breaking the horizontal joint of the wheel casing.

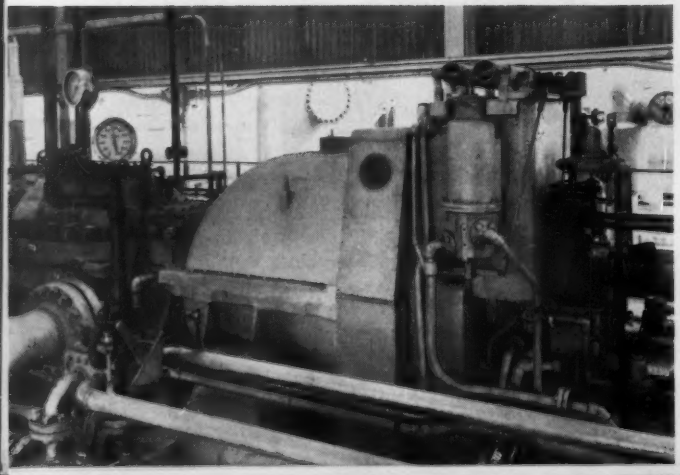
cut steam leakage...



Reliable, long-life metallic-labyrinth seals

To effectively minimize shaft-end steam leakage where shell pressures exceed 75 psig, segmental, high-low tooth metallic-labyrinth seals are used in combination with carbon packing. Between stages, straight-tooth metallic-labyrinth seals are always used. For maximum seal efficiency, minimum clearances between the teeth and the shaft are maintained by precision-machined hook fits in the packing housing. Shaft scoring is practically eliminated since the leaded-bronze segments are spring-backed and can move outward should there be accidental contact with the shaft. When unbalanced steam pressure forces axial movement of the seals, the shoulders of the rings and the housing engage to form a tight steam seal. All labyrinth seals are designed to compensate for thermal expansion, thus assuring a most efficient steam seal at operating temperatures.

reduce maintenance costs

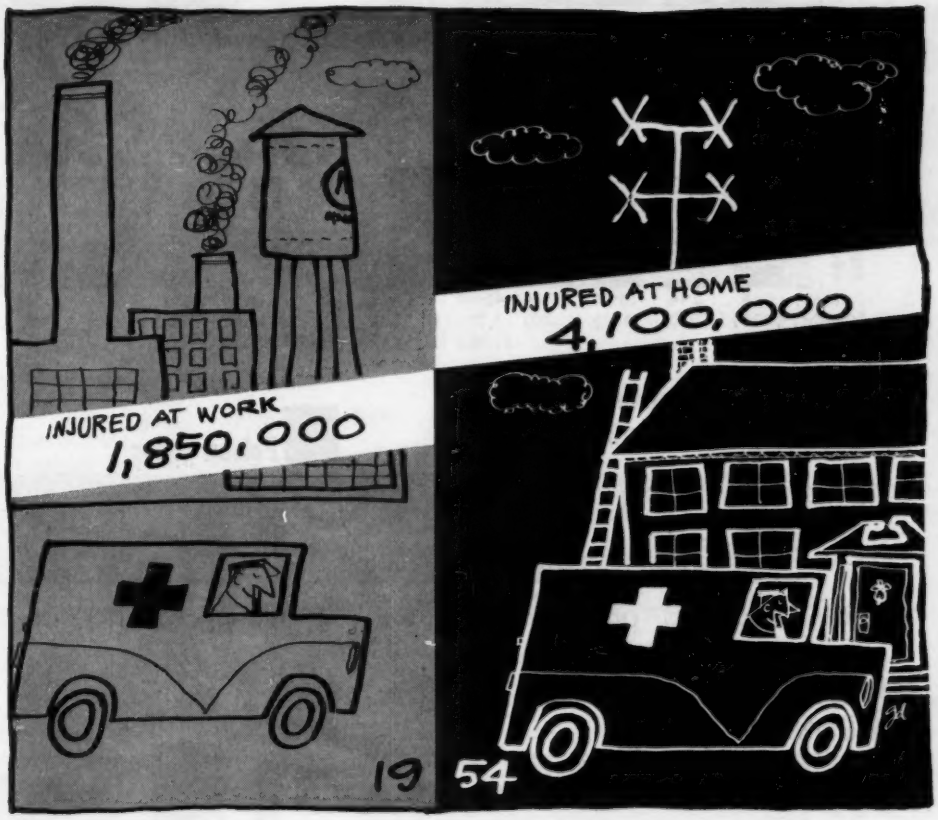


The careful design and manufacture of these steam seals is your further assurance of low maintenance and consistent reliability of G-E High-speed Turbines. Why not check into the many other sound design features built into these mechanical drives? Your Apparatus Sales Representative will be glad to explain the many benefits they offer to your operation. Contact him for further information or write for Bulletin GEA-6232, General Electric Company, Section 241-7, Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

STEVE ELONKA
Associate Editor in Charge



Plant safety is the watchword, but . . .

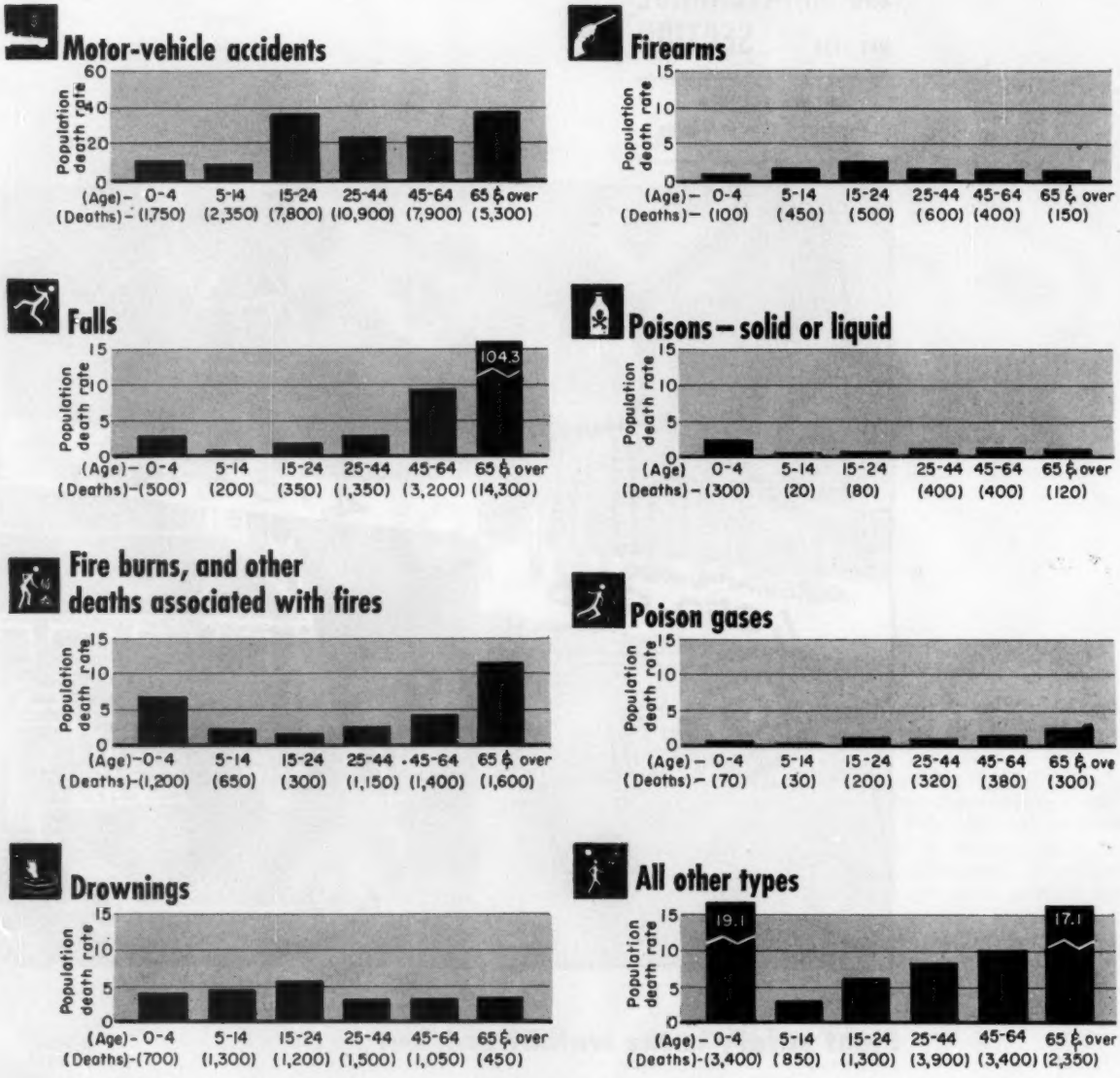
What about off-the-job employes?

► THE AVERAGE HOME is a booby trap compared with the average industrial plant. The home-accident rate is double the work-accident rate, and deaths from home accidents are in direct proportion to these rates. Adding to this the injuries and deaths from other accidents, particularly those involving motor vehicles, produces some startling statistics. Example: In a 10-minute period—two people will die, 170 will be injured at a cost of $185,000.

Common experience of industry is uncertainty about the number of available workers after holidays and weekends. Worker may be uninjured, but can't report because some member of his family has been hurt or killed.

The employe spends less than a third of his weekly time

90,000 people died in '54—who could have been alive today



on the job. Of increasing concern to management is what happens to him during the remaining two-thirds. Several large companies made surveys, were amazed to learn that off-the-job injuries were many times the number of in-plant injuries for the same periods. The surveys made clear the cost-boosting effect of off-the-job injuries because:

1. A certain amount of relief personnel must be available.
2. Training of substitute workers is a necessity.
3. Substitute workers are more apt to spoil products.
4. Accident- and health-insurance premiums go up.
5. Group life-insurance premiums go up.
6. Hospital- and surgical-insurance premiums go up.
7. Efficiency of injured worker is low when he returns.
8. Supervisors lose efficiency under additional work load.
9. Up to 20% of the disability wages that industry pays are for off-the-job injuries, which can be very costly.

Employer and employe both gain, regardless of the motive, by eliminating off-the-job accidents. Preventive action is both humanitarian and economical. By joining in the effort with safety associations, insurance companies and public authorities, industry can do much to lessen this waste of manpower as well as the cost and suffering that go with it.

Accident sources fall into two classes—unsafe conditions and unsafe practices. Industrial safety experts eliminate unsafe conditions; strive constantly to cut out unsafe practices in the plant. But, unsafe practice is a personal matter. When the employe takes it personally—when he becomes "selfish" concerning personal safety—a safety program succeeds. He knows "it *can* happen to me," but he does everything he can to prevent it. He observes and listens at plant refresher courses in first aid, instead of thinking of them as an escape from routine. He isn't self-conscious as "rescuer"

Nobody wins—in this game of chance

Time lost because of work injuries

Though high, the total time lost for 1954 was about 8% less than total for 1953. Total for injured workers does not include time lost on the day of injury nor time needed for medical treatment or check-up after injured personnel returned to work.

	Man-days
Total time lost in 1954	230,000,000
By injured workers	40,000,000
By other workers	190,000,000

Accident costs

Total cost of work accidents in 1954 equaled 1953 cost despite the decrease in number of cases. Lower wage losses, about $950 million, were offset by increased overhead costs of insurance to about $430 million. Estimated medical expenses remained unchanged at about $300 million.

Total cost in 1954	$3,200,000,000
Visible costs	1,700,000,000
Indirect costs	1,500,000,000
Cost per worker to industry	50

or "victim" in demonstrations of artificial respiration or stopping arterial bleeding. His knowledge, he realizes, can mean the difference between life and death even though professional medical help is only 15 minutes away. Like fighting a fire—the first 60 seconds are the most important in resuscitation or using pressure points.

He sets up safety practices at home. Firearms, poisons and medicines can't be reached by inquisitive little hands. Falls, fires, electricity and other hazards of daily living are subjects of family discussion.

Safety-conscious employes are goal of all plant-safety programs. Smart management, long concerned with on-the-job safety conditions, can make big gains by shooting for 'round-the-clock employe—and family—safety. Educational lectures, films and demonstrations covering safety at the plant are standard procedure. Integrating similar lectures, plus films and bulletins pointing up ways and means of accident-free living at home and play, sharpen employe interest, pay big dividends. Major advantages are that such a program:

1. Betters morale, creates good employe relations.
2. Tends to reduce labor turnover.
3. Helps protect employe and family from death or disability.
4. Cuts work of plant medical staff who can devote more time to preventive medicine.
5. Cuts equipment damage and production loss. Man worrying about injury in family is accident-prone on the job.

Total time lost because of injuries at work in 1954 was 230 million man-days. Odd fact is that the injured accounted for only 40 million of these man-days. Other 190 million were lost by workers who (1) stopped to help the injured or discuss accident (2) lost efficiency temporarily after seeing serious accident (3) couldn't work because of damaged equipment or structures. Trend is down by about 8% from 1953, but continued reduction depends, in final analysis, on degree of employe willingness to "think safety"—on the job, at home, everywhere. Natural instinct of man to protect his family responds to safety programs engineered to show advantages, to him, of "thinking safety." Showing that industry's interest extends beyond working hours to his home, family, friends and community stimulates the worker to such thinking.

Compensation laws exist because society agrees that the employer bears responsibility for the employe's welfare. But safety is the responsibility of both. A concept of his own liability in the mind of each employe—a consciousness of his responsibility to himself, his family and others around him—is the real factor in success of a safety program.

"Let every man," wrote the German philosopher Goethe, "sweep his own doorstep, and the whole world will be clean."

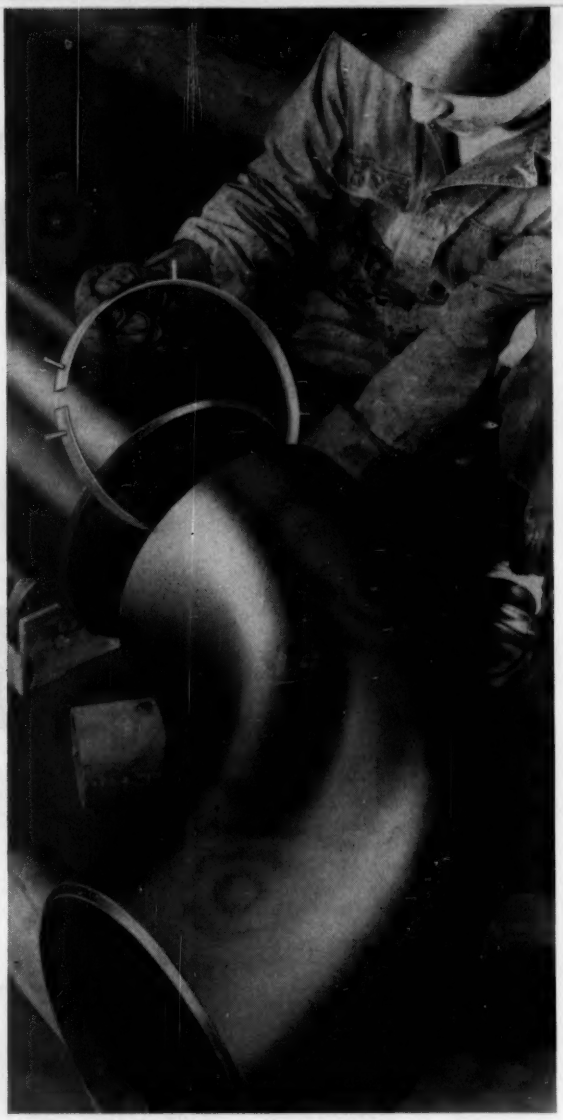
Up-to-the-minute programs supply brooms for United States industrial safety. Be sure to do your part.

Editor's note: Statistical material, courtesy of National Safety Council's "Accident facts"—(1955 edition), which lists figures compiled at end of year 1954.

Mr Plant Engineer: Don't think welded auxiliary piping is 'unimportant.' Failure is often costly—can be avoided by knowing . . .

How to get sound joints in plant pressure piping

By ROBERT C BELLAS, *Assistant Editor*



1 Backing rings keep weld spatter and "icicles" out of pipe, and help welder *(ring in hand)* get needed full penetration

► THE PERFECT pressure piping system would be jointless, easy to insulate and require no maintenance. But since we live in a more or less imperfect world, the nearest we come to this ideal is the all-welded system. And then only if engineering is smart and workmanship closely controlled.

High-pressure high-temperature piping, almost without exception, is designed and installed in accordance with the ASME *Power Boiler Code*, or ASA *Code for Pressure Piping*. However, beyond the spheres of authority of these Codes, a vast amount of pipe welding is dependent on the know-how of the plant engineer or the ability of the piping contractor. Much of the piping is in the class commonly considered "unimportant": soot blower, bypass, auxiliary, etc. But failure of the "unimportant" piping can cut deeply into a plant's profit and loss statement.

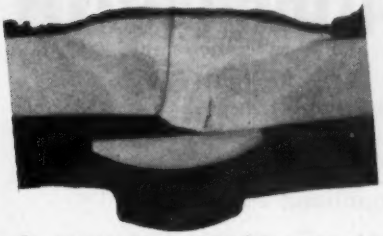
Fundamental design considerations for a welded piping system are the same as for a mechanical joint system. Required diameters are functions of volumetric flow and are so calculated. Wall thickness depends on diameter, operating pressure and temperature, considered concurrently.

Big difference is necessary control of chemistry of the piping to be welded. Ordering pipe by specifying "mild" or "carbon" steel covers a multitude of sins. The supplier, in all honesty, may deliver pipe not of weldable quality. If the installation contractor is not sufficiently experienced, he continues to attempt to weld the material. By the time the difficulty is unearthed, a lot of expense has gone down the drain.

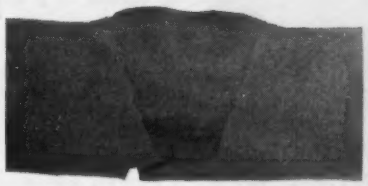
Common causes of trouble: (1) high carbon content (ASME *Code* limits carbon to 0.35% max) or (2) pipe may be high-phosphorous bessemer steel. (ASME *Code* requires electric furnace or open-hearth process). Good way to avoid this is to tell your supplier material must be of weldable quality. Sure-fire way is to specify ASTM number and grade of material when ordering. With delivery, copies of mill-test reports are furnished, if requested, showing heat number and analysis.

Of advantage to engineers is the fact that bulk of headwork in selecting material and welding techniques has been done and is available in ASME *Power Boiler Code*, ASA *Code for Pressure Piping*, ASTM and AWS publi-

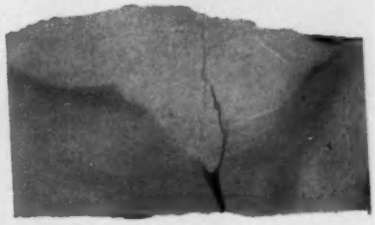
Poor workmanship can mean "built-in stress raisers" — doom joints



2 Improperly fitted backing ring, pipe ends: a common cause of cracking



3 Lack of fusion at root leaves notch. Crack means ultimate failure of joint



4 Incomplete penetration through wall thickness is an invitation to trouble

cations. Since metals, in general, lose strength as temperatures increase, safe working stress values in relation to service temperatures have been established. Sound joint design and welding techniques have been spelled out.

No piping system is stronger than its welded joints. Poor joints generally result unless quality control is exercised from start to finish. First step is use of qualified procedures. A procedure is a "recipe" for producing sound welds under controlled conditions. It is proved (qualified) through severe physical tests of specimen welds. Welding operators qualify under the procedure by proving they can follow the "recipe" and produce sound welds. Reputable piping contractors maintain written records of procedure and operator qualifications, which they are glad to produce and discuss.

Manual arc, covered electrodes, is most common method of field-welding joints in plain-steel pressure piping. All-position welding, particularly of hard-to-get-at joints, requires good fit-up and skilled welders for complete penetration and fusion throughout entire wall thickness. Backing rings may or may not be used although welding authorities generally agree that, even with skilled welders, backing rings give greatest assurance of complete penetration. (Although several processes now eliminate backing rings in pipe welding, the processes are not applicable to welding the root pass in plain steels with conventional covered electrodes.)

Backing rings are fused to, and become part of pipe. They can't be any old piece of scrap, but should closely approach same grade of material as the pipe. Commercially available rings are engineered to a high degree. They (1) help line up pipe ends to be welded (2) can hold root opening to required dimension (3) have contours to minimize pressure drop due to flow restriction and, most important, (4) help the welder get complete penetration. Fig. 1 shows one popular type.

The best backing ring in the world, however, can't nullify poor fit-up of the joint, whether from design or workmanship. Any gap between ring and inside surface of pipe, or any lack of complete penetration and fusion throughout entire pipe-wall thickness is, in effect, a notch. A notch means trouble because it's a "stress-raiser," particularly in plain (carbon) steel.

Look at what happens. Fig. 2 shows poor alignment of pipe ends (often due to difference in ID), which prevented close fit-up of the backing ring. Cracking, starting at the notch, has progressed through the entire weld.

"Integral land" joint, Fig. 3, shows attempt to eliminate ring, provide backing by machining ends of pipe. Nothing wrong with the theory, but eliminating residual notch is a tough problem. Here, failure of joint was only a question of time.

Lack of penetration, Fig. 4, is common fault in attempt to weld joint with no provision for deposition of sound root pass. Where there's a notch, there'll almost always be cracking, and where there is cracking, there'll be ultimate failure. In this joint, as in the others shown, the basic cause of failure was "built in." Chance of compounding the error is the fact that such joints seldom show reason for suspicion under hydrostatic test prior to service.

Authorities agree that the degree of joint penetration is the most important criterion of the strength of a butt joint. Since welded joints are designed to be equal in strength to the parent metal, any lack of penetration through the wall thickness must necessarily reduce the joint strength. Regardless of the type of groove selected in joint design, with or without backing ring, the importance of complete penetration and soundness of the root pass can't be overemphasized.

Tack welds may be thought relatively unimportant but, referring to tacks holding backing rings in position, or holding pipe ends in alignment, the ASA *Code for Pressure Piping* states, "If tack welds are used, they shall either be made by a qualified welder and the same procedure as the completed weld, or be removed during the welding operation."

Referring to the importance of alignment, this *Code for Pressure Piping* further states, "Alignment should provide the most favorable conditions for deposition of the root bead."

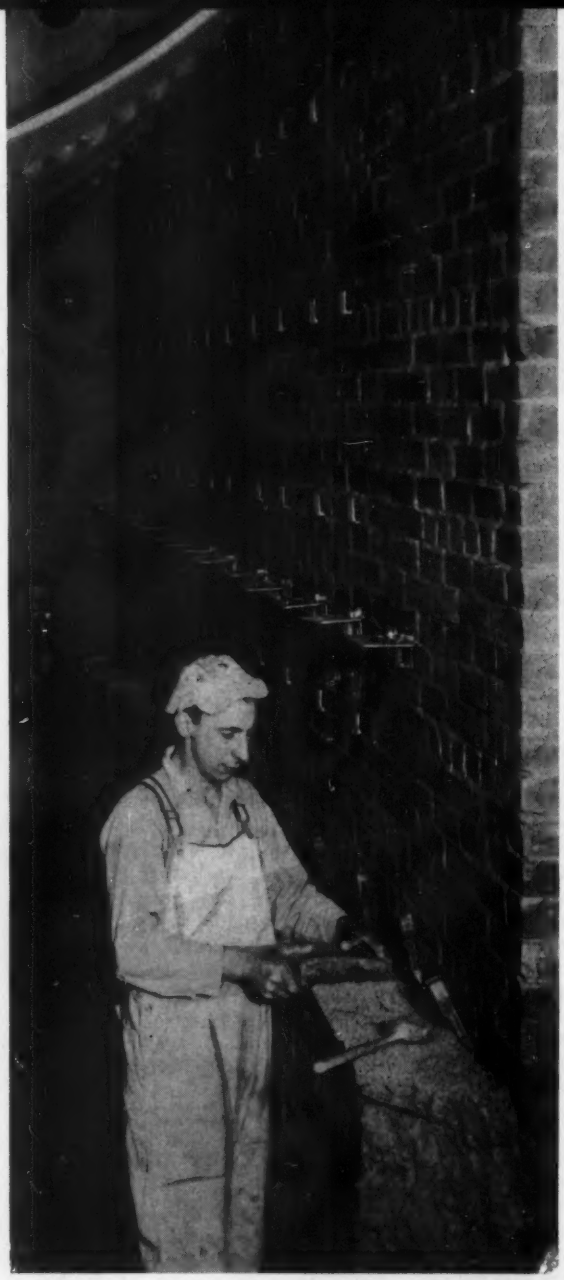
Smart plant engineers can avoid trouble. Though only one joint may be involved in a maintenance operation, select material with care and prove your welding procedures and operators through qualification tests. If it's a job for a contractor, select one of the many who, through experience and integrity, can give you top workmanship.

The editors wish to thank Tube Turns, Inc for Fig. 1, and Grinnell Company for Fig. 2, 3 and 4. Thanks also to American Welding Society for placing its research library at our disposal.

STEAM

Fifteen Q&A

By JACK HARRIS, *Refractory Engineer*



ANCHORS spaced properly will add to plastic wall's life. Rough finish helps wall dry; cut lines prevent face cracks

Q What is spalling?

A Spalling occurs when the "hot end" of refractory lining gets hot, expands from rapid heating, breaking off at ends. This condition can be especially severe when the other end of brick or plastic is relatively cold. Thus, rapid temperature change in only one end of the refractory has same effect as pouring hot water into a cold glass. Spalling is more common with dense brick or dense refractory of any kind, while loosely bonded brick has tendency to resist spalling.

Spalling is probably more common in oil-fired furnaces because of rapid *on* and *off* firing, causing thermal shock. You can also have trouble in furnaces when burning wood refuse, corn cobs or when incinerating paper.

If brick spalling is bad enough so refractory must be renewed, say every six months, change to next higher grade of brick. If that is not complete solution, go another grade higher. Because plastic refractory is one of best spall-resistant linings when properly installed, let's learn more about it here.

Q What are the four general classifications of furnace lining in common use today?

A Low duty, high duty, super duty and high alumina.

Q How many kinds of plastic refractory (specialty refractories) are there?

A Two major types. One is known as plastic refractory, which is a mixture of grog, consisting of ground firebrick, clay and water. This has consistency of stiff mud. It's installed by pounding into the wall with a 2½-pound hammer and then trimming off to required thickness.

Second kind is known as a castable. This is dry material of ground firebrick, clay and a hydraulic setting cement, usually of the high-alumina type. This material is mixed with water and poured into a wood form, like any ordinary cement mixture.

Q What is the most common cause of plastic refractory failure experienced in furnace linings?

A Improper anchorage. Never pound this material onto a thin, glazed wall. First remove old lining, whether 4½ or 9 in. deep. Be sure to enlarge back opening in old wall so new material is keyed into place.

Another cause of failure is improper spacing of anchors. Best practice is to place one anchor per 3 sq ft of wall area. Another reason is heating new wall too rapidly. Plastic is more sensitive to rapid heating than firebrick.

Q How do you avoid irregular cracks in plastic walls?

A Plastic shrinks when it dries, then it cracks. You can control cracking by cutting lines in wall with trowel, to depth of a third of plastic thickness. Make these cuttings

on plastic refractory

Sure, you buy plastic refractory—but do you apply it right? We've seen so much of this excellent material wasted by improper handling that we asked Jack Harris, who supervises its installation, to answer a few important questions. Be sure all your refractory boys get these answers down pat

in 4-ft squares. Such a wall also cracks, but cracks all take place in back of cuts and will not run in all directions over wall area.

Q Where should plastic and castable walls be used?

A Plastic walls stand a much higher temperature than castable walls. They are also more spall resistant. Use plastic in combustion chamber, use castable in same furnace but in areas that are much cooler and away from flame.

Q Are there castables with different properties?

A Yes. There are high-temperature refractory castables, as well as insulating castables. Remember, the higher the recommended temperature, the lower the insulating properties. A great deal of heat lost through the side walls can usually be saved with the proper selection of castable lining.

Q Should wood form used for pouring be left in place to burn out while drying out a castable wall?

A Always try to remove the wooden form before lighting off the furnace. If left in, moisture is prevented from evaporating from surface as heat is applied. This defeats the purpose of drying out in the first place. When the wooden form starts burning, heat is concentrated on wall's surface. That has tendency to glaze the surface, sealing off escape paths from green plastic inside the wall. Then as steam forms, the green wall's surface breaks off from tiny explosions beneath this glazed face. Always dry out your wall with a small wood fire of packing cases if possible, in center of furnace. This is more satisfactory than using one small burner in center of furnace as heat is not as intense.

Q Should a plastic wall be smoothed with a trowel after it's hammered and trimmed to required thickness?

A No. Leave surface as left by trimmer—which has a rough texture. This rough texture greatly increases the surface area available for evaporation when drying out the wall. That allows moisture to evaporate from plastic rapidly and evenly.

Slick surfaces, on the other hand, trap moisture and slow down evaporation, causing surface cracks. Also, if high temperatures contact wall, there will be explosions or popping effect under the surface.

Q Some engineers perforate a green plastic wall with a spike. Is this good practice?

A No. Usually this is not necessary if wall has been left with proper texture. But if you must light off the furnace, perforate wall about 4 in. deep every 5 in. with a ¼-in.-diameter spike. To see how effective this is, look into furnace while it's heating up. You will see a tiny jet of steam coming from each perforation as the wall heats.

Q How much time is needed to cure a specialty setting wall for best service life?

A Good practice is to keep wall temperature below boiling point of water (212 F). Remember, all moisture must come out through furnace face of wall. You must help establish flow of moisture from back to front. Once the moisture flowing to surface establishes path through refractory, it will continue to flow so long as there is heat. This critical time in curing takes about four hours with small wood fire.

Be sure to have wood fire in center of floor or grates, and not against walls. After four hours, increase your fire of coal, oil, gas, etc, gradually, so you reach normal operating temperature in about 24 hours.

Q What is meant by "burning in" a wall?

A Wall is burned in when it has been heated to a point where a ceramic bond has been formed, which begins at about 1800 F. For best results, drying-out and burning-in should be one continuous operation, with temperatures climbing steadily higher.

Q Is air drying of plastic refractory harmful?

A For castables, no—for plastics, yes. Air drying means leaving surface set for a length of time before drying with fire. Trouble is that air evaporates moisture from surface only—and so flow of moisture from back is not started. Then surface cracks as it shrinks. Constant danger here is from moisture flow weeks later when wall looks dry. Then if boiler is fired without proper precautions, wall will fail. Note that this is one of the most common causes of failure. It is a constant headache to refractory contractors who supply the best materials and do high-class work. Their material or workmanship is usually blamed.

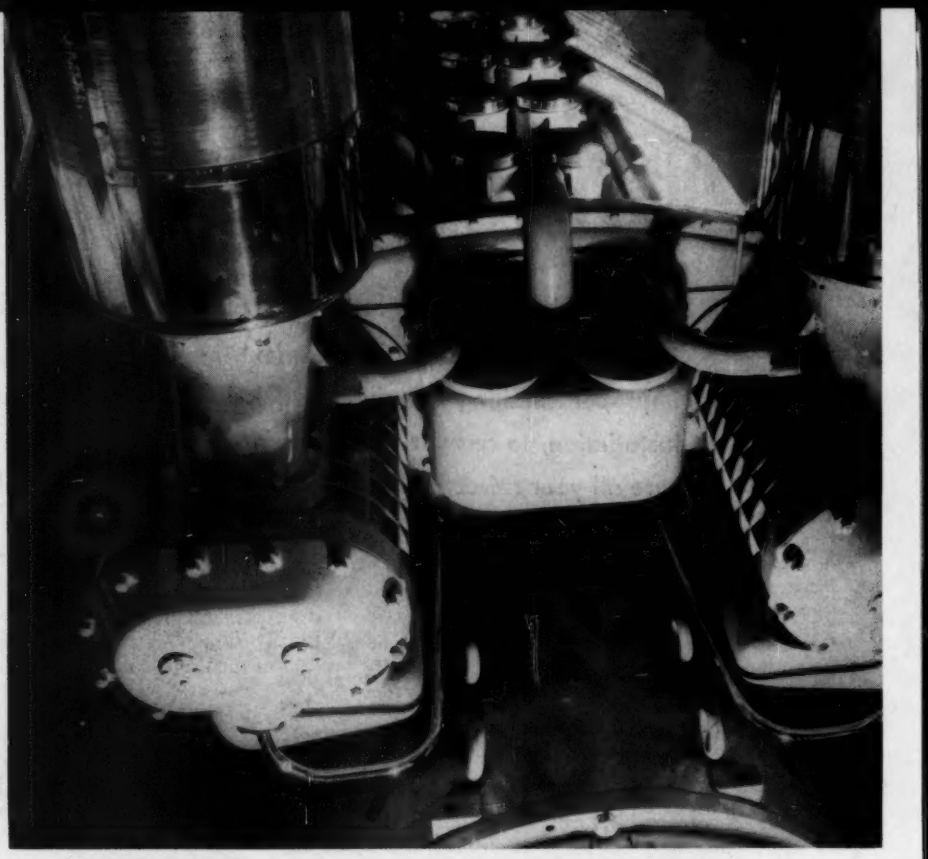
Q If a wall cannot be dried out with fire as soon as it's completed, what precautions must be taken?

A Cover walls completely by nailing burlap to wall, then keep burlap damp. But don't throw water on burlap so it washes off plastic. After fastening the wet burlap, close all doors and dampers so there's no air circulation through furnace. That helps burlap stay moist longest possible time.

Q How long can refractory specialties be stored?

A Castables can be stored in dry places indefinitely. Plastic shipped in usual cardboard of moistureproof packing is good for about six months, in a cool dry place.

If plastic dries out from long storage, you might save it by slicing in slabs a few inches thick and placing wet burlap between all layers. But this will not always save the plastic. Best practice is to order it as needed. Then you won't have to store it. Be sure to follow these hints carefully.



1 Intake filters on a modern diesel take their suction from the engine room. The ventilation system must provide enough air for operation of the engine indoors

Good ventilation takes the heat off

► To a diesel engine, air is as important as fuel and lube oil. Though we can see the level in a fuel tank fall as the engine runs, we're not so conscious of how an engine uses air. Yet without enough air an engine may overheat, smoke, misfire or give other trouble.

What air does. Air flowing into a diesel-engine plant performs these jobs: (1) Cools the engine, generator and other machinery. (2) Provides a breathing supply for the operators. (3) May be the source of intake air for the engine cylinders if an outside intake is not used.

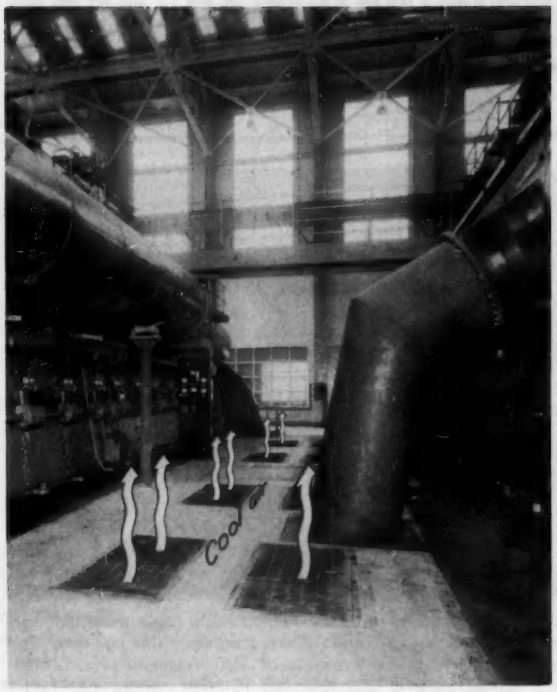
One manufacturer figures that the heat lost to the air in a power plant building runs between 300 and 350 Btu per hr per kw of rating of the engine-generator combination. Using the higher value in a plant rated at 1000 kw, we find the heat loss is 350 × 1000 = 350,000 Btu per hr. So you see that ventilation of even a small unit can be tricky unless it's studied.

Air flow into the building is important. Since heated air rises, the air in the usual plant enters through the lowest windows or other openings, Fig. 4, and leaves through the upper windows or ventilator, Fig. 3 and 4. In some plants, louvers or other intakes are used in the basement and the air is supplied to the engine room through ventilation gratings in the operating floor, Fig. 2.

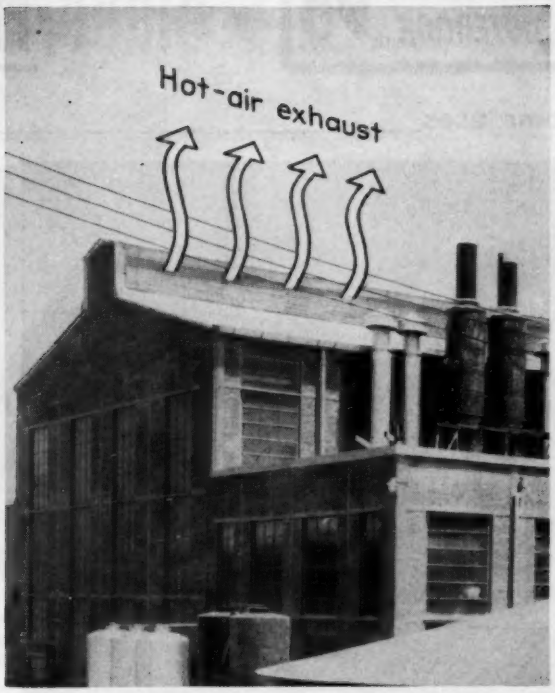
Quantity of air, for ventilation only, varies from about 31 to 8 cfm per kw of rating with a temperature rise during passage through the building of about 9 to 40 F. In other words, the higher the temperature rise (and the more heat absorbed by the air), the lower the air flow required. But to play safe it is best to provide enough air to keep the temperature rise within reasonable limits—say, 20 F.

Generators used with diesel engines usually have fan blades on the rotor. These suck air into the unit, Fig. 4, cooling the windings and other parts. But the blades cannot be expected to circulate air through the plant building. In fact, if you rely on this method of air movement to ventilate the building, you'll soon find the generator temperature rising. This is because air is being recirculated through the generator and its temperature rises as it makes one pass after another over the warm windings.

Ventilation of the plant building, either natural or mechanical, is needed to prevent this: 1. *With natural ventilation,* windows or louvers are provided to admit air. Roof ventilators of some type, Fig. 3, permit hot air to exhaust easily, with minimum resistance. 2. *Mechanical ventilation* uses either a supply-air fan to blow cool air into the building, or an exhaust fan to suck out hot air. In large plants both types of fans may be used, in addition to some roof ventilators.



2 Ventilation gratings in the floor of a large diesel plant. Air flows through these gratings from the basement below

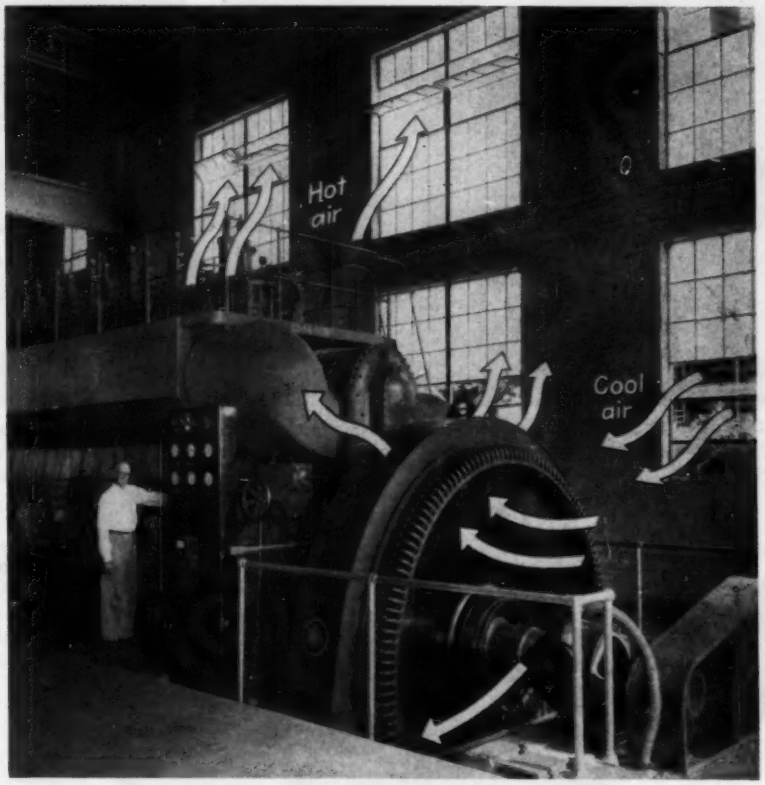


3 Outlet louvers in the roof of a large diesel power plant. The warm air rises to these louvers after absorbing heat

your diesels

Ejector stacks, used in some plants, are arranged so the discharging exhaust gas from the engine induces an air flow out of the building. When connected to draw hot air from the building this type of stack can replace or supplement an exhaust fan. Of course, by pulling a certain amount of air from the building, an equal amount must flow in from the outside, giving the desired ventilation. Be sure, when using this method, to have the manufacturer advise you on how the unit is to be installed. Then you'll be certain of good results.

You get better performance from your engines and have a happier, more comfortable crew if you ventilate your plant right. Just follow the rules given here, work with the engine manufacturer and the consulting engineer. Then you cannot go wrong on any of the details. Remember, a diesel can be starved for air and is almost certain to show ill effects of some kind.



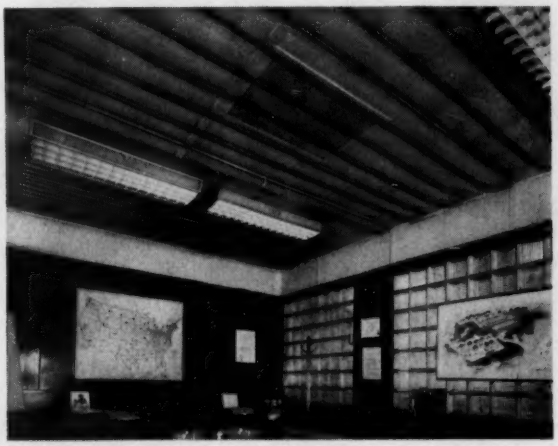
4 Air paths that may be followed during operation of the engine in this plant are shown by the arrows. The generator circulates its own cooling-air stream

OPERATORS' NOTEBOOK 96

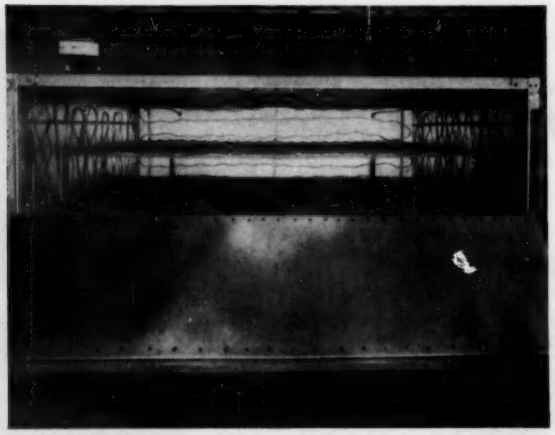
Today, you can heat

Some uses

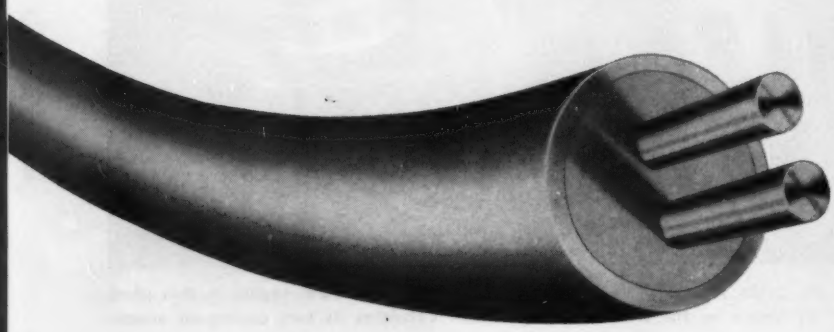
HOT LACQUER spraying is speeded up by wrapping the heating cable around spray tank. This keeps lacquer at uniform high temperature needed for glossy finishes of parts being sprayed



FACTORY OFFICE is radiantly heated with cable mounted on ceiling spaced on 6- and 12-in. centers. Ceiling area is about 15x20 feet. Two circuits of 220 v, single phase, are used. Cable here is 200 feet of 15 watt output per foot



INDUSTRIAL OVEN is lined with cable to heat the polyvinyl chloride sheets to forming temperatures. Here 220 volts, two circuits, single phase, produce 18 watts per foot, or 5.4 kw

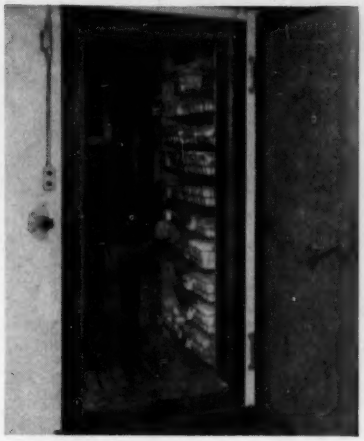


Here's cable data

► MINERAL-INSULATED copper-sheathed electric heating-cable shown is rugged, yet flexible enough to install for a wide range of purposes. Unit withstands up to 480 F in continuous operation and is produced in a wide range of lengths to meet heating requirements. It is compact and highly resistant to mechanical abuse, as well as to corrosive action.

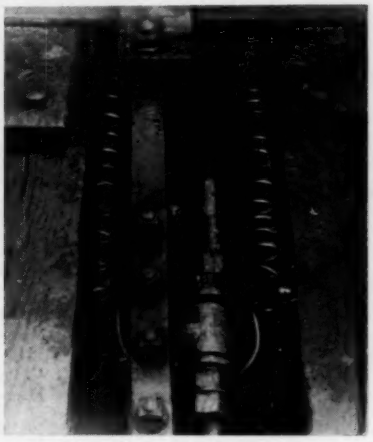
quickly with electric cable

By STEVE ELONKA *Associate Editor*

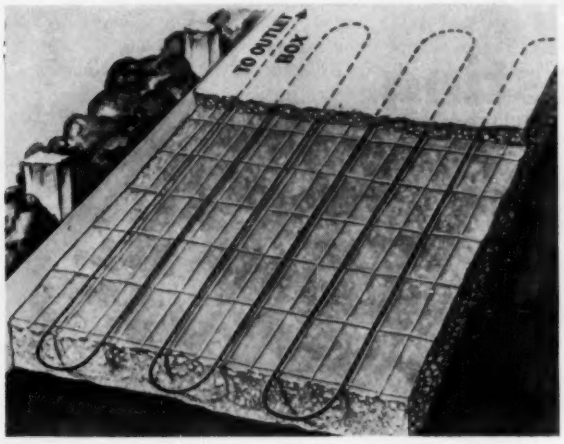


QUICK-FREEZE room door in commercial freezing plant is wired to prevent door freezing closed. Here 18 ft of 24-v cable are mounted around door frame

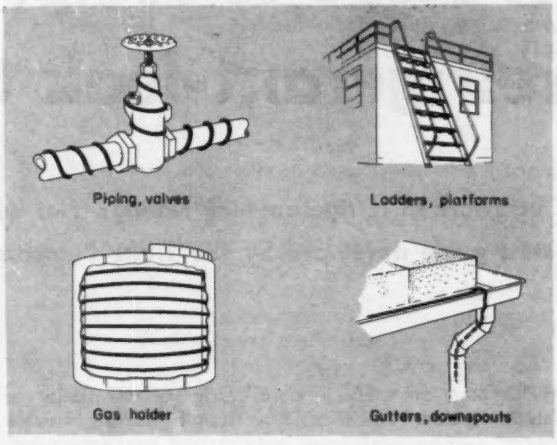
RAILROAD SWITCH is being wired with about 300 ft of cable to prevent freezing. Four parallel circuits of 220 v utilize 9.5 kw per switch on this job



TIE ROD is also wired to prevent ice formation. This is a handy hookup for plant railroad where freezing slows down coal unloading and other operations



DRIVEWAYS are wired to melt ice and snow. Cable has self-annealing copper sheath, permanent magnesium oxide insulation and two copper-nickel resistance wires for these jobs



OTHER USES are for process lines, tanks, ladders, gutters, downspouts, platforms. Also handy to have a supply on hand to prevent steam lines freezing during emergency shutdowns

Nonflammable — cannot burn — contains nothing to create fumes or blinding smoke. Copper sheath provides a permanent ground. Seamless sheath and brazed joints are waterproof. Cold section can be furnished long enough to make connection away from moisture or corrosion areas.

Conductors are copper-nickel alloy of 38 mils diameter (0.038 in.). Insulation is finely divided, highly compressed magnesium oxide. Cable OD is 246 mils (0.246 in.). Voltage rating is 300-v rms, maximum. Temperature rating is 482 F, maximum (this is hot-spot rating of cable alone). Conductor resistance is 0.0623 ohms per ft per conductor at 68 F, nominal. Standard termination is 85 C. Voltage test is 1500-v rms, 60 cycles, for 5-minute period. Insulation resistance is 3000 megohms per M ft at 68 F, minimum.

Besides uses shown in photos and sketches, it maintains correct heat for flow of viscous materials, prevents steam pipe freezing during shutdown.

—*Continental Electric Equipment Co.*

REFRIGERATION

FIRST
OF TWO
ARTICLES

11 steps to foolproof refrigerant-leak testing

Guesswork in refrigerant-leak testing? Not when you use this latest guide developed by The Trane Company

► PLANNING TO INSTALL more refrigeration capacity to handle summer air-conditioning loads? Having trouble playing detective with small leaks in your existing system? Then the latest guide used by The Trane Company is for you. It's your road map to a refrigerant system that's free of even the smallest leaks. Here, in 11 easy-to-follow steps, is the gist of it.

1 If test pressures exceed relief-valve setting or safe-pressure limits on bellows used in pressure controls, remove these items before building up pressure. (*Test before covering pipes or turning on condenser water.*)

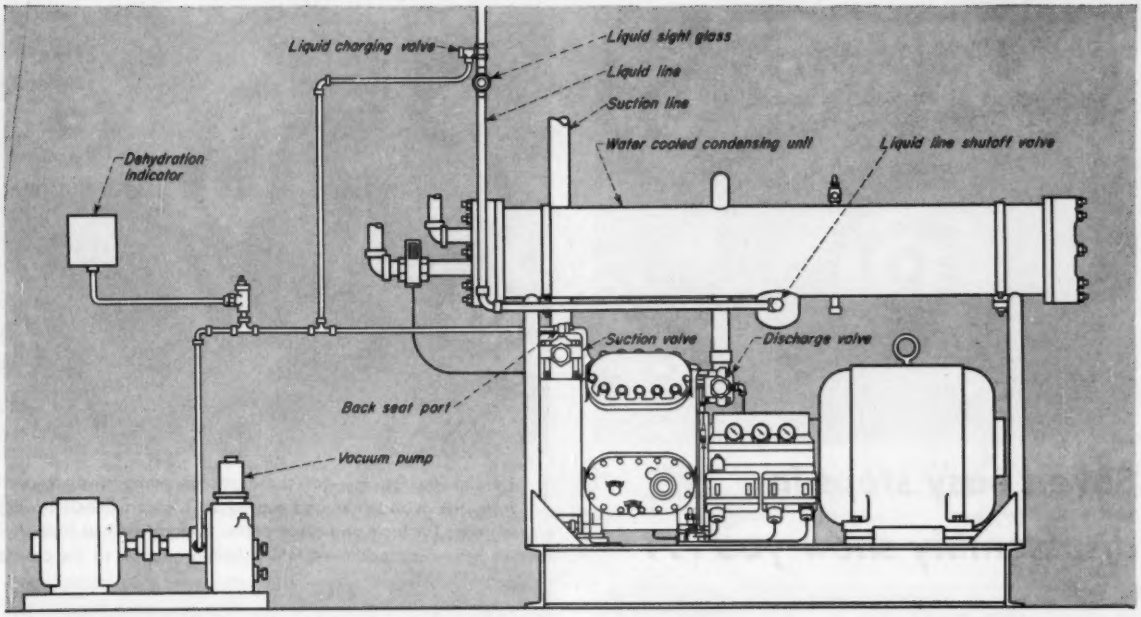
2 Plug the thermostatic-expansion-valve inlet to make sure both high- and low-pressure sides of the system are fully tested. Common way to do this: Remove cap screws and insert a plug in valve's flange body. Hold plug in place with a solid diaphragm over the inlet. And don't forget to disconnect the external equalizer line from the expansion valve.

Remove the thermostatic expansion valve's power assembly during leak testing to avoid damaging it.

3 For high-side test connection: Close compressor suction, discharge valves to make sure you won't be testing the compressor itself. Connect a drum of dry CO_2 to the liquid charging valve. A word of caution: Don't use oxygen or acetylene instead of CO_2. You'll be inviting a possible explosion. And be sure to have a gage and regulator on the CO_2 drum, to control pressure.

CO_2 pressure can build up to 1000 psi or more if it isn't watched. Second gage, between regulator and liquid charging valve, reads test pressure. Install this gage with a flare tee.

Admit CO_2 to system's high side until gage reads 225 psig or pressure specified by local codes. Close regulator and charging valves. Then disconnect drum just ahead of the tee. To read high-side test pressure, cap tee and open the charging valve.



RECOMMENDED METHOD of connecting your vacuum pump to the refrigeration system before charging it with refrigerant

4 For low-side test connection: Admit CO_2 to the suction line through the external equalizing pipe that was disconnected from the expansion valve (see step 2). Drum should be upright and fitted with standard gage and regulator. Gage, installed with flare tee, between regulator and equalizer line reads test pressure. To isolate drum from system, install a packless diaphragm valve between regulator and test gage.

After admitting CO_2 slowly until test gage reads 125 psig (for Freon-12 systems), close regulator and packless diaphragm valve. Then disconnect drum at the packless valve and cap the valve's open side.

Don't forget to check with local codes for test pressures used with different refrigerants.

5 With system under test pressures, tap the sweat or solder connections with a rubber or rawhide mallet. Hit hard enough to start faulty connections leaking, but not hard enough to break a sound joint.

6 A drop in gage pressure shows up a major leak. You can spot such leaks by tracking down escaping gas noise.

To find smaller leaks brush all possible leakage points with soap solution and watch for bubbles. A few drops of glycerin in the soap solution insures good bubbling. Using distilled or rain water for the solution yields best results.

7 After bubble-testing of high- and low-side systems, break charging-valve and external equalizer-line connections; allow CO_2 to escape. Repair all leaks spotted by gage pressure loss or by bubble testing. A word to the wise: Don't try to repair leaks while the system is under pressure. Also, take bad joints apart, clean and remake them as a new joint. Don't add more brazing material over a poor connection.

8 After repairing leaks, charge high- and low-side of the system with a small quantity of Freon-12. Use five pounds of F-12 for each ten tons of refrigeration, adding larger part of the F-12 to the low side. (For charging, follow the same steps used for CO_2, above). Next, disconnect refrigerant tank, hook up CO_2 drum and build up to original test pressures.

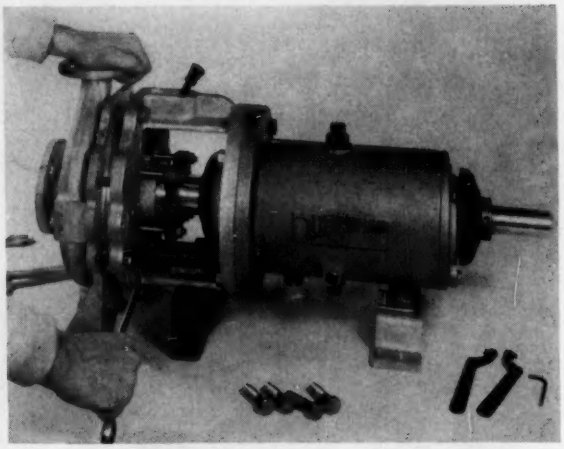
9 Check the entire system with a halide leak detector, photo on facing page. Make sure you run the exploring tube over all parts of the system under pressure. Small amount of escaping refrigerant colors the flame green. Big leak may put out the flame or turn it dense blue with a reddish tip. If F-12 in the air colors the flame regardless of the searching tube's position, ventilate the room thoroughly.

If an open flame can't be used, re-run the bubble test where leaks have been repaired. If additional leaks show up, you'll have to run through repairing and testing steps again.

10 After you've tracked down all system leaks, let the equipment stand 24 hours under test pressures. If gages show pressure changes—taking into account room-temperature changes—you're up against more leak testing. But remember: Pressure will rise or drop about three psig for each 10-F rise or fall in temperature.

11 After final leak testing and repairing, release pressure, remove all expansion-valve plugs and reassemble the equipment for normal operating conditions. You're now set to pull vacuum on the system, see drawing at top, to prepare it for charging.

Next month we'll talk about pulling vacuum, inspecting and charging the system with refrigerant.

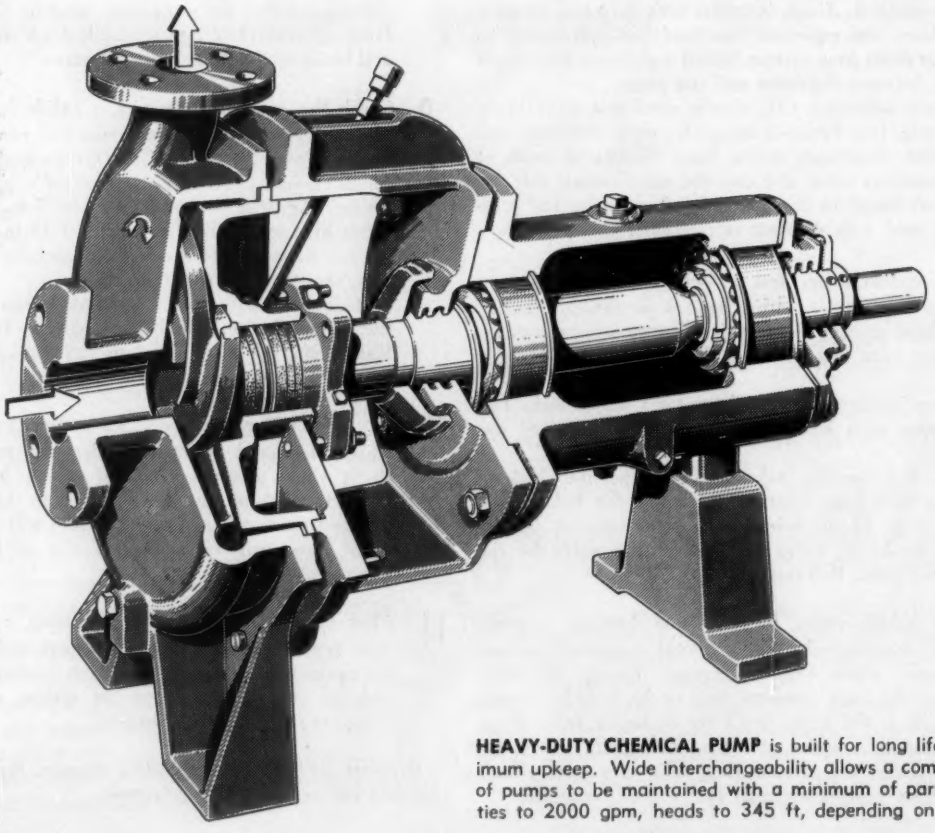


1 Here's your pump—for these photos pump was removed from the foundation and moved to a clean bench having enough area for tools and other parts. Support unit as here and remove hex-head capscrews, which fasten adapter to the casing

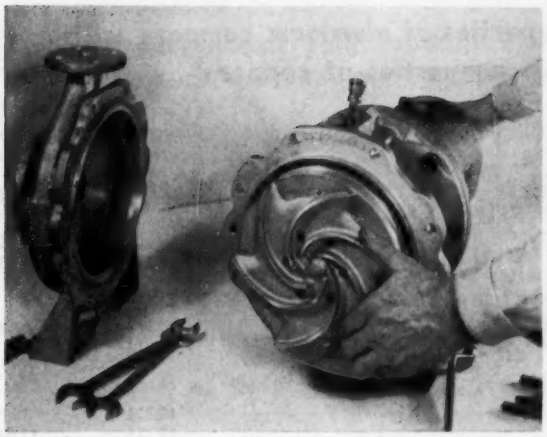
Seven easy steps in disassembly show you . . .

How to overhaul chemical process pumps

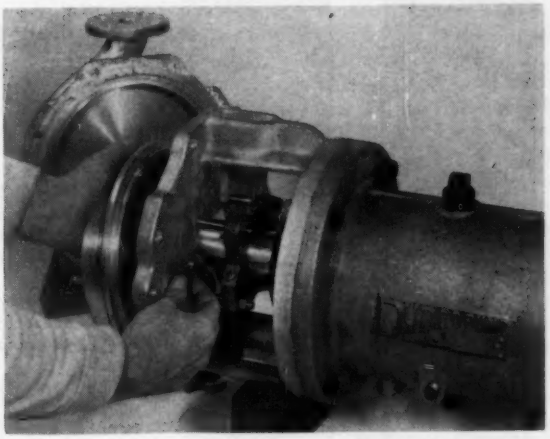
By R F SHARPE, *The Duriron Company, Inc*



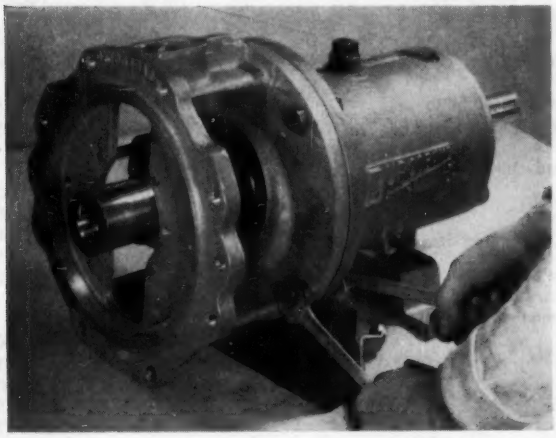
HEAVY-DUTY CHEMICAL PUMP is built for long life with minimum upkeep. Wide interchangeability allows a complete range of pumps to be maintained with a minimum of parts. Capacities to 2000 gpm, heads to 345 ft, depending on pump size



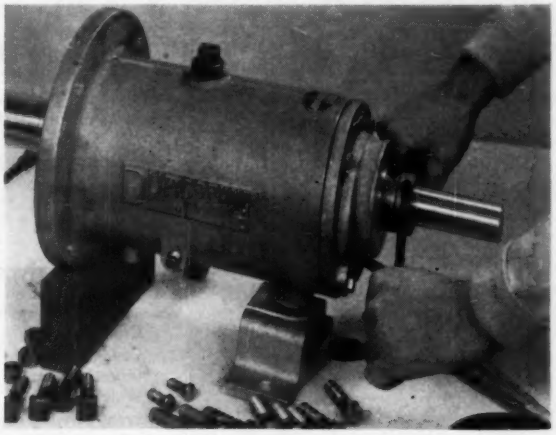
2 Slip casing from frame adapter, exposing the impeller. Remove the impeller, which is threaded onto the end of the shaft, by holding the shaft with your right hand and the impeller with your left. Turn impeller counterclockwise



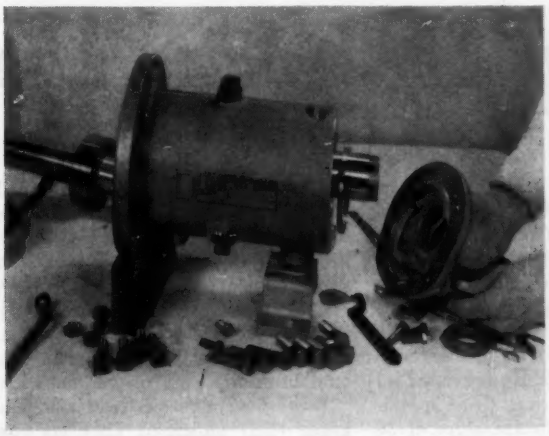
3 Loosen the capscrews on either side of the pump shaft and withdraw them. The rear coverplate, which is fastened to the frame adapter, is then easily removed, as shown here. Other parts of pump are now more readily accessible to you



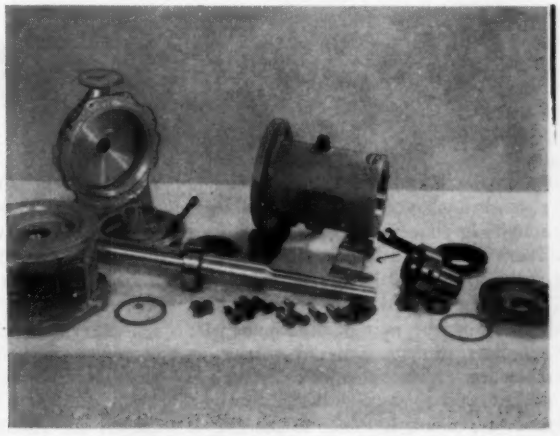
4 We're now ready to unfasten the adapter from the frame. Use two box wrenches, as shown. Loosen all nuts and then withdraw the adapter from the frame. More of the shaft will now be visible for inspection or maintenance, as in Fig. 5



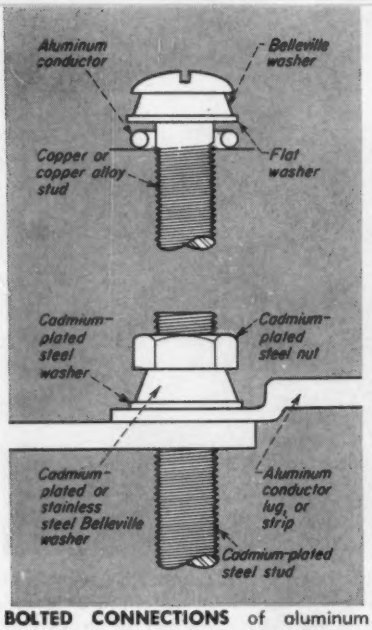
5 Loosen the capscrew in the locknut of outboard bearing. Using spanner wrenches, rotate the locknut counterclockwise to remove it from the threaded portion of the shaft. Be careful not to damage the threads on either shaft or nut



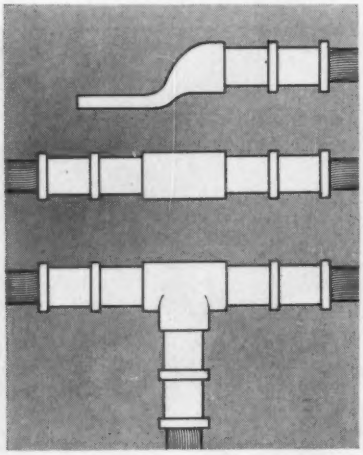
6 Remove the shaft and front bearing through the forward end of the bearing housing. Loosen the four hex-head capscrews, holding the outboard bearing cover to the bearing housing. Slide cover off the bearing housing, as shown here



7 After you slip the rear bearing from its housing, the pump is completely disassembled, ready for inspection and maintenance. Complete disassembly as shown here is necessary only when the inner parts require attention from the engineer



BOLTED CONNECTIONS of aluminum wire to copper strap use spring washers



COMPRESSION LUGS and connectors are recommended for aluminum building wire

How properties of aluminum compare with properties of copper

	Copper, electrolytic	Aluminum, EC alloy
Specific gravity at 20 C (68 F)	8.89	2.703
Melting point, degrees F	1980	1216
Boiling point, degrees F	4500	4100
Thermal conductivity at 0 C (32 F), calories/cm²/cm/sec	0.513	0.277
Electric conductivity at 20 C (68 F)		
100-mil wire, annealed, %	100	62-63
100-mil wire, hard-drawn, %	96.16	61.0
Specific resistance at 20 C (68 F), ohms-mil foot		
Annealed	10.371	16.58
Hard-drawn	10.785	17.022
Thermal expansion coefficient, 32 F to 212 F, per F	9.122×10^{-6}	13.20×10^{-6}
Resistance coefficient at 68 F, per F	0.00218	0.00220
Atomic weight	63.54	26.97
Hardness, Brinell (hard temper)	103	50
Modulus of elasticity, lb per square inch	16×10^6	10×10^6
Tensile: psi per 100-mil-diameter wire		
Annealed	35,000	12,000
Hard-drawn (minimum)	64,900	27,000
Weight per cubic inch at 20 C (68 F), lb	0.323	0.0975
Volume in cubic inches per lb at 20 C (68 F)	3.1	10.25
Comparison for equal conductance, %, relative		
Dc resistance	100	100
Diameters	100	126.5
Cross sections	100	160
Weights	100	48.5
Current-carrying capacities	100	1112
Comparison for equal diameter, %, relative		
Cross sections	100	100
Conductances	100	61-63
Dc resistances	100	160
Weights	100	30.5
Current-carrying capacities	100	79

Let's see how aluminum building wire

► WITH COST OF COPPER continuing to skyrocket, chances are you'll see more activity in aluminum-building-wire area. There has been a letdown in promotion of the light metal in the last few years, but recent indications point to renewed activity on the part of aluminum wire suppliers. Substantially lower cost is, of course, aluminum wire's principal advantage over copper; its light weight, however, makes it easier to handle. It pulls into conduit faster because of less static weight and frictional drag. For the same current-carrying capacities insulated aluminum building wires weigh 30 to 40% less than copper wires, the larger figure relating to larger sizes of wire where insulation weight is proportionately less.

Larger sizes of aluminum conductors will be required to get equivalent current-carrying capacities. Table above compares these capacities of aluminum and copper wires. Values are based on 1953 National Electrical Code specifications for ambient temperature of 30 C (86 F). When circuit is long, and voltage drop is prime consideration in selecting wire size, aluminum conductors two sizes larger give you approximately same voltage drop as copper in Awg-size range. In circular-mil sizes there is a lesser increase since reactance becomes of greater importance compared with resistance. Larger diameters of aluminum conductors often make larger-size conduit necessary, but this does not ordinarily offset large economy in initial cost of building wire.

Properties of electrical-conductor-grade (EC) aluminum alloy are compared with properties of electrolytic copper in table above. Properties of aluminum show that greater care is required when making splices than is

How current-carrying capacities of aluminum wire compare with copper wire

Wire size		Current capacity, amperes							
		TW or RW 3 in conduit		TW or RW 1 in air		RH 3 in conduit		RH 1 in air	
Awg or Mcm									
Alu-minum	Equiv copper	Alu-minum	Equiv copper	Alu-minum	Equiv copper	Alu-minum	Equiv copper	Alu-minum	Equiv copper
12	14	17	15	21	20	17	15	21	20
10	12	25	20	34	25	25	20	34	25
8	10	34	30	46	40	38	30	55	40
6	8	46	40	67	55	55	45	80	65
4	6	59	55	88	80	71	65	105	95
2	4	80	70	118	105	97	85	143	125
1	3	92	80	139	120	109	100	164	145
1/0	2	105	95	164	140	126	115	193	170
2/0	1	122	110	189	165	147	130	223	195
3/0	1/0	139	125	218	195	168	150	260	230
4/0	2/0	164	145	252	225	193	175	302	265
250	3/0	181	165	286	260	214	200	340	310
300	4/0	202	195	315	300	239	230	374	360
350	250	218	215	353	340	260	255	424	405
500	350	269	260	433	420	319	310	521	505
750	500	336	320	550	515	399	380	659	620
1000	750	382	400	655	655	458	475	785	785

Correction factors for values above

Above values are for 30 C (86 F) ambient temperature. For higher ambient temperatures multiply by temperature correction factor. For 4 to 6 conductors in conduit, multiply by 0.8; for 7 to 9 conductors, multiply by 0.7.

C	F	TW or RW	RH
40	105	.82	.88
45	113	.71	.82
50	112	.58	.75
55	131	.41	.67
60	140	0	.58
70	158		.35
75	167		0

compares with copper

necessary for copper. Electrical-conductor-grade aluminum alloy does not possess the high modulus of elasticity of copper. For this reason the area of contact face must be larger. Mechanical connectors are manufactured with this in mind. (Mechanical connectors are used almost exclusively for aluminum wire and cable.)

Linear expansion of aluminum is approximately twice that of steel, and about 1½ times linear expansion of copper. This characteristic makes it necessary that any pressure connectors without all-aluminum parts, have tension-compression members with expansion coefficients equivalent to aluminum, or the connectors must be made with compensating spring follow-up. If such precautions are not followed, successive changes in temperature cause the connector to loosen. This problem is ordinarily licked quite easily by putting a spring-type washer (such as Belleville washer) under head of screw or under stud nut, see sketch on facing page. Steel washer has large bearing surface to insure large pressure-contact area between lug and copper strip or bus. Steel parts: (1) tin or cadmium coated (2) stainless steel.

Compression lugs and connectors are manufactured in a variety of styles, some of which are sketched on opposite page. You apply them with mechanical or hydraulic compression tools that make sure you get a reliable connection. They're approved by National Electric Code, while welded lugs and connectors are not. There's a lot to be said for welded connections, however; they're smaller, and some users consider a good welded lug better. Trick is that a really skillful welder and special inert-gas welding equipment are required. Improvements in materials and techniques can be expected to come along as more aluminum is employed in industrial wiring.

Oxide film forms on freshly cleaned aluminum in a matter of seconds when exposed to air. Keep in mind this hard, light-gray film has high dielectric properties. On the good side, it protects wire from corrosion. Oxide film is thin, easily removed with abrasive cloth, steel wool or Fiberglas brush. Commercial oxide inhibitor, or petrolatum, can be used to prevent film from reforming. You can buy compression connectors that are designed to break up the film during compression, and that come provided with inhibitor.

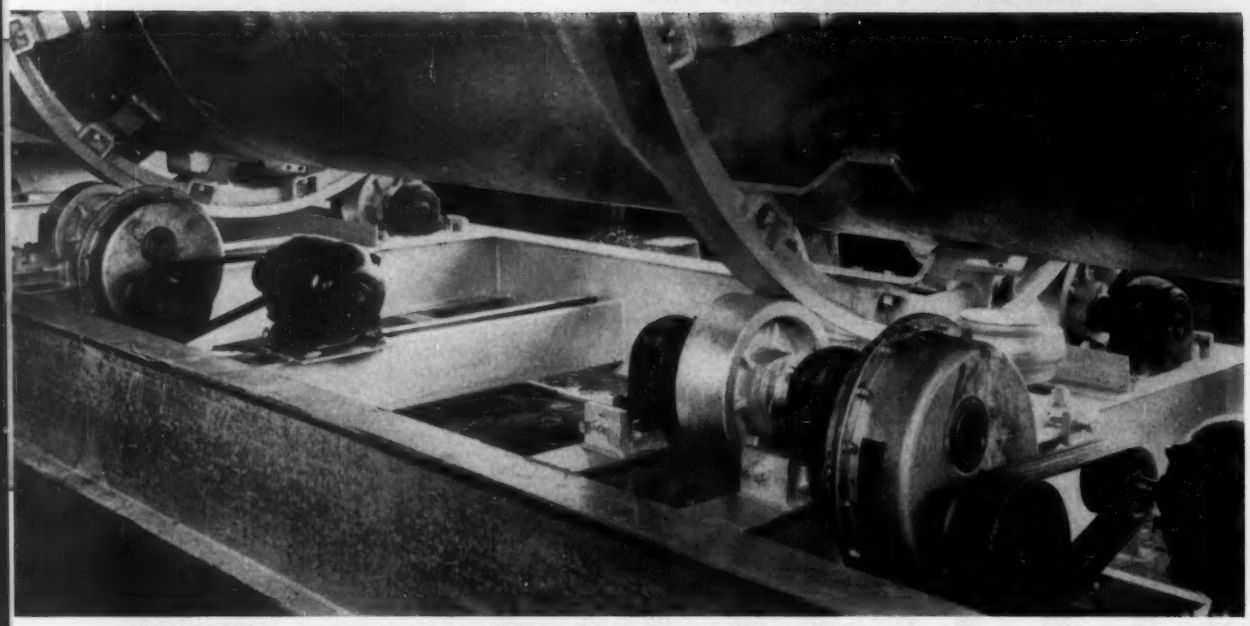
Electrolytic reaction between aluminum conductor and copper stud or bus does not usually become problem in interior wiring if standard procedures are followed. It can give you trouble where the atmosphere is humid and contains contaminants. Right type of inhibitor and special precautions, however, make use of aluminum wire practical in almost any atmosphere.

Extra care required when making aluminum-wire connections should not discourage anyone. The simple procedure does not substantially increase labor costs over copper wiring.

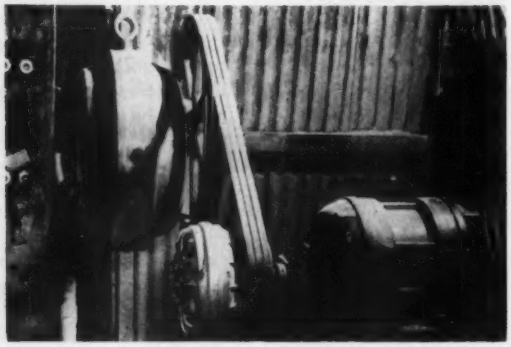
Here's how to make connections:

1. Clean aluminum contact areas to remove oxide film. (This is not necessary if welding or compression-type connector that breaks up film is used.)
2. Apply oxide inhibitor liberally unless inhibiting compound is already in connector, and attach connector.
3. If you're wiring with solid conductors, in range of No. 12 to No. 8 Awg, you can form eye for connection to screw terminals. Insulation should be shaved off like sharpening pencil, not cut square since nicking wire may result in end breaking off.
4. When connecting to copper studs or bus, use spring washer and large-surface flat washer.

Basic technical data for this article was obtained from building wire manual of Kaiser Aluminum and Chemical Corporation.



PARALLEL-SHAFT reducers driving a sand dryer. Motor runs at 1750 rpm, V-belts and reducers provide 50 rpm output speed



CONCENTRIC shaft-mounted reducer drives this bucket elevator. Hydraulic sheave cushions shocks to motor

SPEED of 3 hp 1750 rpm motor is reduced to 31.5 rpm by this parallel-shaft drive performing canal gate service

Cramped for space?

► IF A SHAFT-MOUNTED REDUCER solves your transmission problems (facing page, top text), you need to know how to select a unit to suit your application and what to watch for when installing and maintaining it.

Selection. Manufacturer's literature makes it easy to pick out the right unit when you know motor horsepower and speed, desired driven speed and type of driven machine.

Horsepower and speeds are determined by the motor and driven machine. Be sure to select drive on the basis of motor horsepower, not driven machine horsepower.

Service classification is determined by the application. The catalogs have tables to help you determine this. In general, a higher classification requires a larger reducer.

Installation procedures vary with the reducer selected, but these items must always be considered: 1. Space occupied by the unit, including space for movement when overload release operates or when torque arm length is adjusted. 2. Accessibility for checking oil level and changing oil. 3. Proper shaft length for mounting the reducer. 4. Torque arm attachment.

See that shaft extension is straight, clean and free from burrs. Exact mounting position and method of securing to shaft varies with the manufacturer.

Never hammer on input shaft or housing. This may cause bearing damage or shaft deflection and undue bearing load.

Mount V-belt sheave on input shaft as close to reducer as running clearances permit. See that driven sheave diameter is at least as large as the minimum recommended. Then mount motor sheave and align with reducer sheave.

The V-belt drive may be in any convenient position. But for parallel-shaft units where torque arm turnbuckle is used

Shaft-mounted reducers may solve your transmission problems

Shaft-mounted speed reducers extend the useful range of the V-belt drive down to 10 rpm or less, using standard 1750 or 1160 rpm motors. They can be used with any type of motor, and with other power sources. Units are available up to 60 hp at 100 rpm output speed, can be used under steady and shock load conditions.

All shaft-mounted speed reducers are mounted on the driven machine shaft. This saves floor space, eliminates need for a foundation or other support.

Connection between the motor and speed reducer is a V-belt drive. Ratio of the V-belt sheaves multiplied by ratio of the speed reducer gives the total reduction. If desired, variable-speed pulleys can be used.

Construction. Essentially, the reducer is a helical gear unit with single or multiple reduction stages, assembled in an oil-tight housing. The low-speed or output shaft is hollow for mounting unit directly on the driven shaft. Interchangeable bushings allow adaptation to common shaft sizes.

Units use either ball or roller bearings; gears and bearings are splash lubricated. Oil seals may be rubbing or labyrinth type, depending on manufacturer's preference.

Units are made in two general types: Concentric type has driving and driven shafts on the same center line. Parallel type has input and output shafts parallel to each other.

The concentric unit, produced by one manufacturer, has double-reduction gears, is available in 13 to one and 20 to one ratios.

Parallel-shaft units, produced by four manufacturers, have either single- or double-reduction gears. Ratios are about 4 or 5 to one for single reduction, 11, 14, 15 or 20 to one for double reduction.

All units have a torque arm or tie rod and turnbuckle to resist torque load reaction and prevent housing from turning. On parallel-shaft units, adjusting turnbuckle increases or decreases center distance of the belt drive to regulate tension. On concentric units, mounting motor on slide rails or automatic motor base provides the required tension adjustment.

Overload release can be added to the tie rod or torque arm to protect reducer and driven machine.

On concentric reducers, overload release completely disengages the torque arm from the reduction unit if sudden shock load or jamming occurs. The reducer then revolves around its hollow output shaft, removing all torque from the driven machine.

Overload release for one of the parallel shaft units cuts off current to the motor and shortens effective length of the torque arm to loosen the belts.

When required, reducers can also incorporate backstops to prevent backward rotation of the driven shaft.

Consider a shaft-mounted speed reducer

to adjust belt tension, the most effective position puts belt pull at right angles to a center line joining output and input shafts.

Fasten torque arm or tie rod to secure reducer in one of its recommended positions. Torque arm should preferably be at right angles to an imaginary line between its point of attachment to the reducer and the output shaft.

Follow torque arm mounting instructions carefully. If improperly installed, forces will increase and premature bearing failure may result. If overload release is used, torque arm position must allow for its operation.

Lubrication and maintenance. Shaft-mounted speed reducers are shipped without oil. Before starting, add the type and quantity of lubricant indicated in the instruction manual. Mounting position, ambient temperature and output speed affect the oil specifications.

One manufacturer recommends the following maintenance practices: Don't add oil while the unit is running. You will get an improper indication of oil level. Remember that overfilling causes overheating, underfilling may cause gear failure.

Keep the housing vent open. This lets air escape as unit comes up to operating temperature and reduces oil foaming. It also prevents leakage through the oil seals caused by pressure difference between inside of unit and surrounding atmosphere. When a unit is repainted, vent may inadvertently be sealed. Check this if oil leaks at shaft seals.

During the first 100 hours of operation, the gears "wear in." Small metal particles removed from the high points of gear and pinion teeth are suspended in oil. If the same oil remains in the unit after the initial period, it acts as a lapping compound and gear teeth wear rapidly. To avoid this, drain after the first 100 hours, then flush housing with a light oil and refill with fresh or filtered lubricant to correct level. This holds for both new and repaired units put back in service.

Check lubricant level monthly and add oil if required. Under normal conditions, change oil every 2500 hours or every six months, whichever occurs first. Under severe conditions, like rapid rise and fall in temperature of the housing, with accompanying sweating of the inside walls and resulting sludge formation, operation in moist or dusty atmospheres, or in the presence of chemical fumes, it is usually necessary to change oil more frequently. Check oil condition when checking its level.

Where reducers operate in a very humid atmosphere, moisture condenses inside the housing each time the unit cools. This condensate rusts gears, pinions and ball bearings, causes ultimate failure of these parts. Drain condensate once each week or month, depending on rate of accumulation. Stop the unit and let oil settle for about ten minutes before draining so condensate will be at bottom of the housing.

If oil leaks through the seals, check for proper oil level and type, and see whether vent is open.

Under normal operating conditions, oil temperature inside the housing should not be more than 80 F above room temperature. Overheating may be caused by high belt tension; excess churning when level is too high; continuous operation at loads greater than capacity of the unit (this will cause failure—remedy immediately); poor quality lubricants or dirty oil, causing rapid gear and bearing wear.

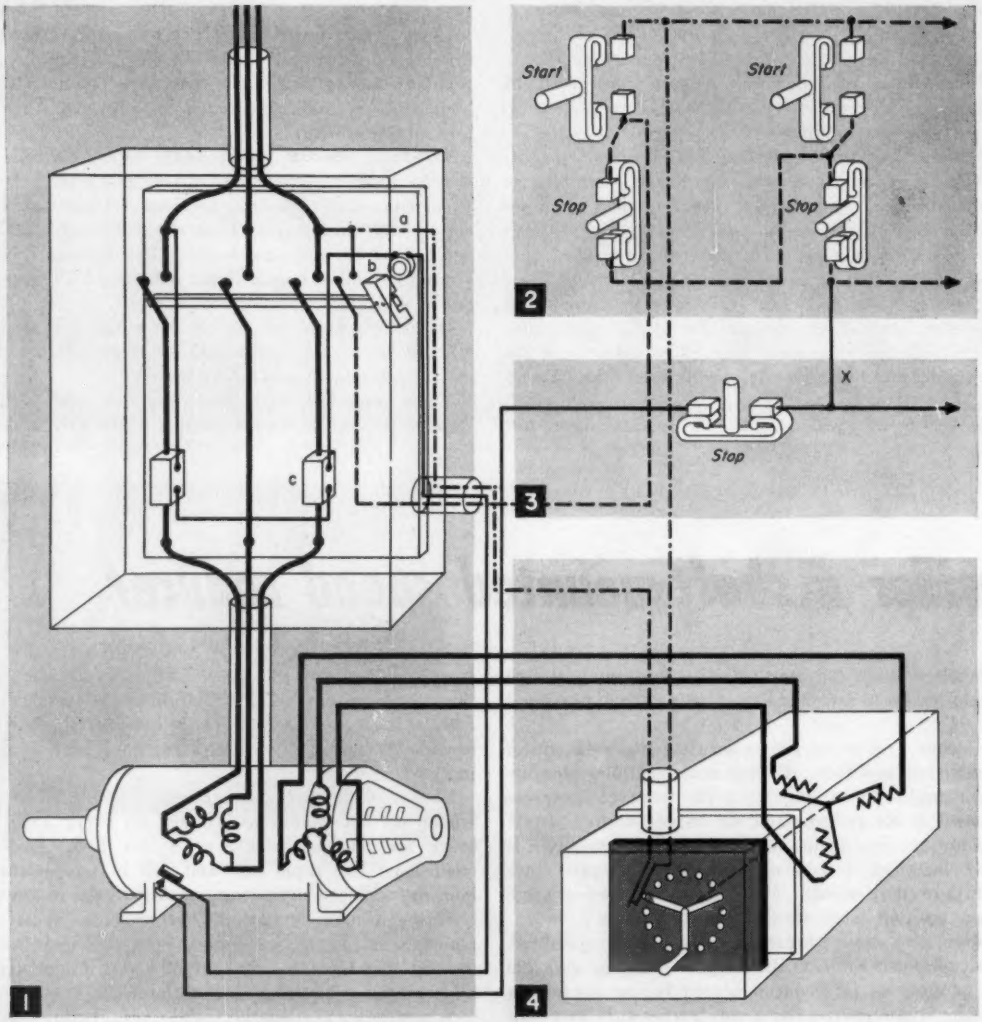
Plant

Electrical

Fact File

10 hookups to start induction motors across the line

No. 2: MOTOR HOOKUPS



BASIC MAGNETIC STARTER can be tied in with control and safety devices to handle variety of operating requirements of squirrel-cage or wound-rotor-motor drives. Modifications available for one or two phases; additional auxiliary contacts, etc.

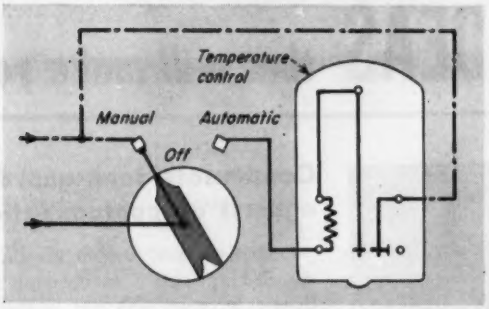
Pushing start button energizes coil (a), closing contacts and connecting motor. Circuit through coil is maintained by contacts (b) until opened by stop button or overload relay (c).

1 **THERMAL RELAY** in holding coil circuit is embedded in motor windings where dangerous overheating opens circuit and shuts down the motor.

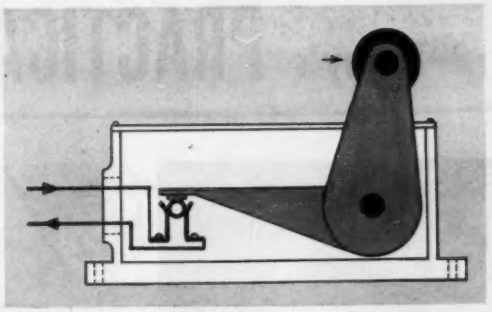
2 **MULTIPLE PUSHBUTTON STATIONS.** Additional start-stop stations can be added for safety and efficiency. Connection X used at end of circuit. Start buttons are in parallel, stops in series.

3 **EXTRA STOP BUTTONS** installed at any location where quickly stopping machine will increase safety, reduce possibility of damage to machine.

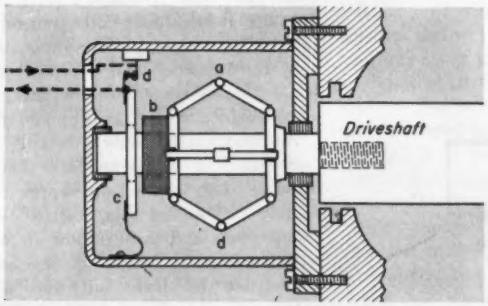
4 **ROTOR CONTROL RELAY** on resistance controller is in series with start-button circuit, prevents starting motor except when all resistance is in rotor circuit, which is often desirable.



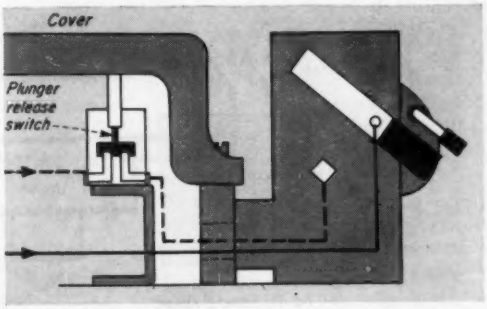
5 **AUTOMATIC CONTROL,** by thermostats, pressure switches, float switches and similar devices, energizes and de-energizes holding coil of starter. Single-pole, double-throw switch can be used to disconnect automatic device and start or stop motor manually. Pushbutton stations shown at (2) can't be used with this arrangement, but lockout switches (10) and protective relays (1) and (4) fit in.



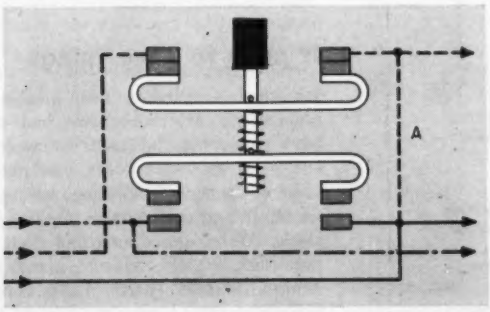
6 **LIMIT SWITCHES** are available in several styles. Function is to open circuit when machine is not operating properly, and prevent starting until trouble is removed. Roller type shown shuts off motor when roller is pushed to right. Limit switches are adaptable to many purposes: overtravel of machine tools, detecting jam-up of material, stopping conveyor belts that run off pulleys at side.



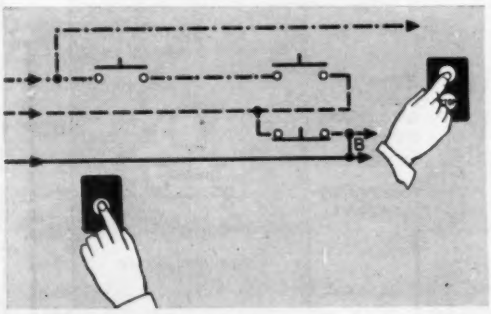
7 **CENTRIFUGAL SWITCH** direct-connected to motor stops it when excessive torque demand slows it down. Similar arrangement with small pulley is applied to belt to detect excessive slip. As speed falls, arms (a) contract, pushing drum (b) against switch plate (c), opening contacts (d). With type shown, hold start button until motor accelerates. Modification has starting relay that shorts contacts.



8 **LOCKOUT SWITCHES** located where accidental starting of machine may cause injury to personnel or damage to equipment. Operator or setup man can keep holding coil circuit open, can use pin or padlock for extra safety. Plunger- or roller-type switches kept closed by cover or guard prevent motor being started when cover or guard has been removed, exposing parts dangerous to personnel.

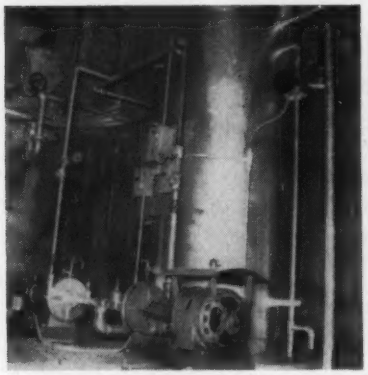


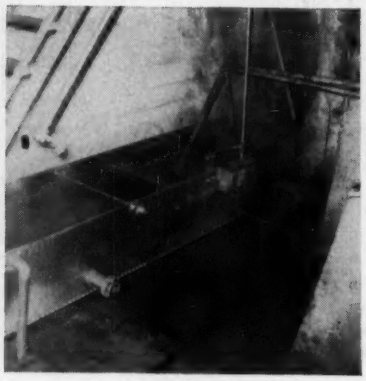
9 **JOG BUTTON** enables operator to move machine very small amounts during setup, repair, or clearing jammed material. Motor runs only as long as jog button is depressed. Jog button can be inserted anywhere in control circuit. Connection (A) is used where jog button is at end of control circuit.



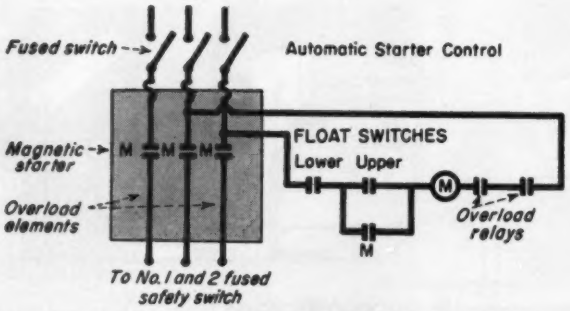
10 **TWO-HANDED STARTING** at dangerous locations keeps idle hand out of harm's way. Additional button in series with start button or regular start-stop station pays off in safety. Does not affect starting at other stations, or use of jog button. Connection (B) used when station is at end of circuit.

Today's PRACTICAL IDEAS that will make your

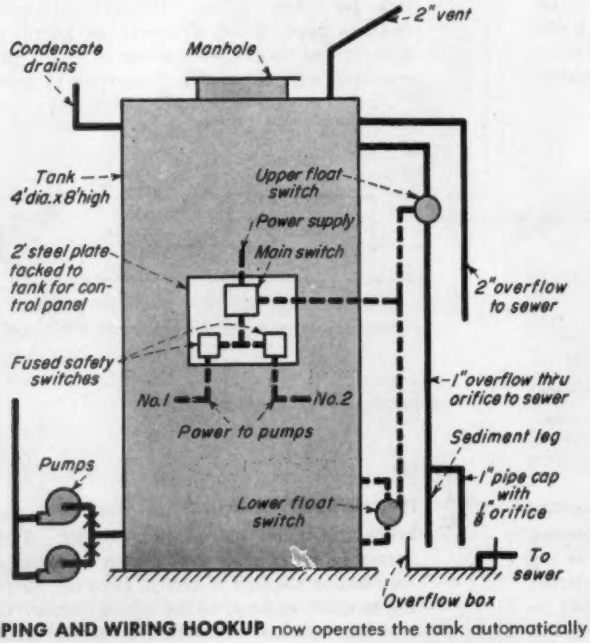




CONDENSATE TANK is enclosed, overflow box shows whether there's oil in tank



THIS WIRING DIAGRAM controls the condensate level



PIPING AND WIRING HOOKUP now operates the tank automatically

Condensate tank guards against oil contamination

Collection tank, bottom sketch, was installed to replace an open-top tank. Reason for open tank was to show oil from drains of various pieces of equipment. New unit collects and returns condensate, helps us check for oil, and is enclosed to keep hot condensate vapor from escaping. Vapor from old open tank would often fill room, condense on walls and ceiling, creating a maintenance problem.

Condensate collects automatically and, at the same time, allows tank to overflow some condensate from surface when tank fills. Overflow feature shows operator if oil film is collecting on surface. Tank is completely enclosed except for top vent and overflow pipes. Gage glasses show level in tank, also oil on surface as level goes up and down.

As condensate drains into tank, level rises until it overflows into one-inch overflow leg containing upper float switch. When leg fills, switch closes, pump starts and the overflow stops. A 1/8-in. orifice in bottom of leg allows condensate to drain out and upper switch is reset. Pump runs until level in tank reaches lower float switch, then stops. Pump won't start until tank fills and overflows a set amount, photos, top.

Condensate draining from orifice collects in overflow box before going to waste. If oil appears in overflow box, power to pumps is cut off, tank overflows to waste through 2-in. overflow pipe until excess oil is removed and oil source is found by operators.

G GREEN *Hutchinson, Kan.*

It pays to save things

It's good practice to keep usable replacement parts when two bad units have enough useful parts to assemble one good unit. But only one part of some equipment always goes wrong. So we never find that part in our salvaged stock. Maintenance men find their salvage supply cluttered with many good items with no likely use. These must be thrown on the heap.

Your salvaged parts can often serve for other things beside replacement in original assemblies. List of uses for spare salvaged parts can help mechanic solve some real tough jobs if he hasn't experienced need before.

power services flow more smoothly

STEVE ELONKA, *Associate Editor*

Carbon brushes. Useful for making brushes smaller than salvaged stock. Very helpful to arc welders for patching holes in iron castings. Carbon is clamped against hole until successive passes have built up the metal to required thickness. Carbon can be removed easily as weld won't stick to it. Special notches, rough keyways or pin inserts can be built up by sawing and dressing carbon to needed shape. Flexible shunts can repair leads for adjustable rheostats, relay contacts, automatic switches, etc.

Steel files are excellent for holding sharp edge when fashioned into a knife or wood chisel. Many old-timers prefer a bearing scraper made of a 12-in. three-cornered file. Some retempering is needed as files are very brittle. Small rat-tail and round files make excellent layout scribers and awls. Durable scrapers for used firebrick, rusty or painted surfaces can be made in the forge. Just turn over about ¾ in. of end of a 14-in. flat file and grind a chisel edge. Don't make cold chisels or center punches from files, for even though temper is drawn, there's danger of chips flying off when struck with a hammer.

Cartridge-style fuses. All sizes have useful fiber tubing. One ferrule sawed off the 30- and 60-ampere sizes makes good file handles. Tubing itself makes good insulation to slip over bolts in electrical assemblies to reduce leakage or flash path to ground.

Hacksaw blades from power saws. Worn or broken blades are always in greater demand than supply for scrapers and rough-work knives. Handsaw blades are less useful, but serve for light spatula and straightedge work. Since saw blades are also very brittle, same precautions apply as for tools from files.

Special fabrications. Salvaged parts often allow a homemade idea to develop into a practical reality right on the job. One of ours was a plug-in welding bus that saved many steps and lots of wear on portable cables. Plug, contact and boxes were built from parts reclaimed from retired "H" type oil circuit breakers. Other parts were 60- and 100-amp fuse cases, 1-in. ebony asbestos board and 1-in. pipe nipples. Only material brought out of stock was 300-amp solder lugs and ¼x3-in. stove bolts.

We also built three special relays to indicate by bell alarm when 600-volt dc-feeders tripped out, to name a few.

T E MILLER *Chattanooga, Tenn.*

What would you have done?

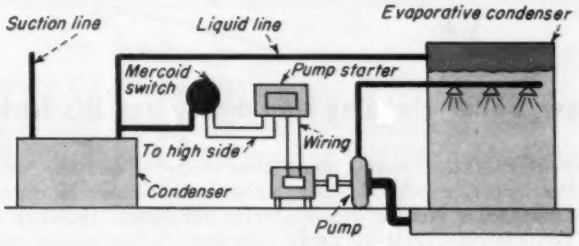
Our new oil-fired heating plant is rated for plenty of expansion. We had trouble with a burning temperature at burners during summer months when load was about nil. No. 6 heavy residual oil left the heaters at 225 F. But low velocity and heat loss from long manifolds dropped temperature between 155 and 160 F at burners. Because of economics and red tape, we couldn't install a secondary heater at boilers just then.

We bypassed heated oil back to storage tank to keep oil temperature up to minimum. But this brought trouble. When hot oil under pressure escaped into low-pressure return line to tank, some oil flashed into vapor. As return lines' outlet in our four tanks was within 3 ft of high- and low-suction lines in tanks, pumps became vapor-locked and wouldn't pump fuel oil.

Checking showed that each 2½-in. return pipe was threaded into a coupling, welded into top of 25,000-gallon horizontal tanks. We didn't want oil to fall into tank from inlet. We had to prevent heat dissipation and sludge formation. Yet oil couldn't be allowed to go much below surface of oil in tank, regardless of level.

After draining one tank at a time, we removed return line and drilled 1-in. holes through pipe on 3-in. centers for pipe's length. Since installing this perforated pipe, return oil flows out through 1-in. holes near level, allowing bubbles to dissipate on surface. This solved vapor-binding problem. What would *you* have done?

C F BISHOP *Fredonia, N. Y.*



Maintaining constant pressure

We have several evaporative condensers outdoors. This time of year it's hard to maintain a steady pressure on refrigeration units because of the big change that occurs in outside temperature from day to night.

I installed a mercoid switch on water-spray pump that's controlled by head pressure of compressor, sketch. Now, when pressure drops, water pump stops, leaving only blower fan to cool condenser coils.

I find it helps very much in maintaining a constant pressure in system.

L A NOVAK *Pittsburgh, Pa.*

(*Continued on page* 130)

More PRACTICAL IDEAS

Begins on page 128

Look, fellas, can this happen?

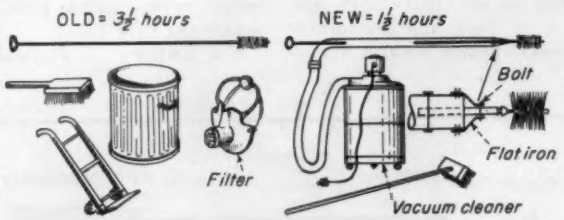
When I told our chief electrician that construction crew had reversed the connections on a 100-hp wound-rotor motor, he said, "You're nuts, they won't run that way!" The construction lad's division connected the 550-volt primary leads to secondary slip rings—secondary leads to stator primary windings.

First trouble was with motor's automatic starter. She flashed severely at the primary-side clapper (actually connected to the slip rings). Intermediate clappers failed to go through their steps. Therefore, to get unit going, the shift electrician "plugged" the contactors in with a stick. This practice is in order in mining circles, as you might guess.

Upon checking the current with a flux-type clip-on ammeter, I noticed that the indicator had a peculiar swing. We were measuring the "slip." Then, with a voltmeter we attempted to measure the voltage at the stator leads. It was zero. At the slip rings we obtained 3-phase balanced voltage. Pretty well proved my point, but I'm darned if that "chief fellow" didn't check the conduit runs out before he was convinced. Anyway, it was his way of doing it.

L McWILLIAMS
Shawinigan Falls, Q.

EDITOR'S NOTE: *Send in your "Can this happen?" and receive a check if it's accepted for publication in* POWER.



Now, boiler cleaning isn't messy and it's faster

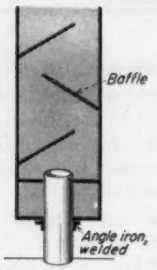
We cut our firetube-boiler cleaning time in half. Punching tubes and cleaning firesides used to be a dreaded, messy, 3½-hour overtime job. Tools we used before are shown in sketch.

We bought a large industrial vacuum cleaner, then made a tube cleaner from length of 2-in. electrical metallic-tubing. Instead of pushing soot ahead, as with old tube brush, soot is sucked into tubing and into vacuum cleaner. Now very little soot gets into firebox. Hardly any gets past rear tube sheet to collect, fall out when boiler rear doors open.

For hand brushes, stiff push-broom was substituted. This brushes down tube sheets so men can work farther from soot. Cleaner is emptied about twice per boiler. Handling cleaner is easy since it has casters. Best of all, there is little soot in air. So men are comfortable, need no breathing filters.

All remaining soot is picked up with attachments that came with vacuum cleaner. To prevent danger from spontaneous combustion, no soot remains in cleaner between jobs. Now, entire boiler-cleaning operation is done more thoroughly, without mess, in about 1½ hours. Cost of new equipment will soon pay for itself in saving man-hours.

H R MATHISON *Elmont, N. Y.*

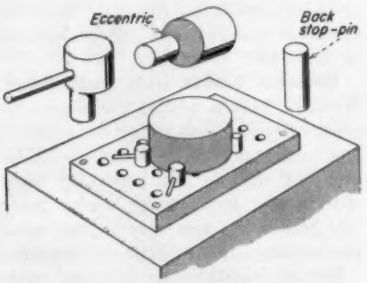


Wooden muffler stops noise

We have a 400-psi turbine-generator with 135-psi extraction. Backpressure is 30 psi. During late summer and early fall, we're limited on our hydrogenerator capacity because we must maintain our lake level. Our process-steam demands are at a minimum. Then we are forced to relieve 30-psi steam to atmosphere at frequent intervals to balance system.

Problem was exhaust noise during season when nearby residents had their windows and doors open. To solve it, we built a 3-ft-square by 8-ft-high muffler of 1-in.-thick pine boards, with three baffles, sketch. Inside surfaces of mufflers were covered with old felt. We slipped muffler over the 16-in. vent pipe and rested it on a few pieces of angle iron. Now our noise problems are over.

P DAVIDSON *Ticonderoga, N. Y.*



This cam vise-plate holds large work

When you have to hold large work and regular bench vise isn't big enough, make a bench cam-plate vise, sketch. Drill holes in parallel lines in a plate or cast-iron block. Make two cams from solid-bar stock of 1¼-in. diameter. Add couple of back-stop pins, and you have a gripping device. By changing location of cams or stop pins you can hold a wide variety of work easily.

C H WILLEY *Penacook, N. H.*

(*Continued on page* 132)

Largest and most colorful skyscraper in "the world's most air conditioned city." Houston's new landmark is owned jointly by The Texas National Bank and The Continental Oil Company. Floor space is approximately 560,000 sq. ft.

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OF HOUSTON

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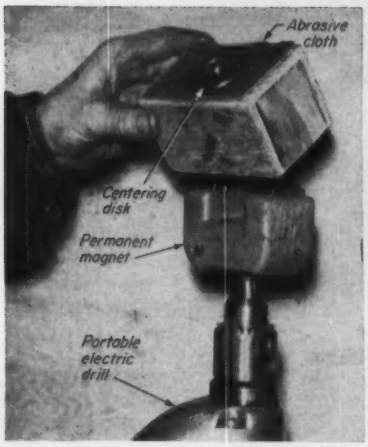
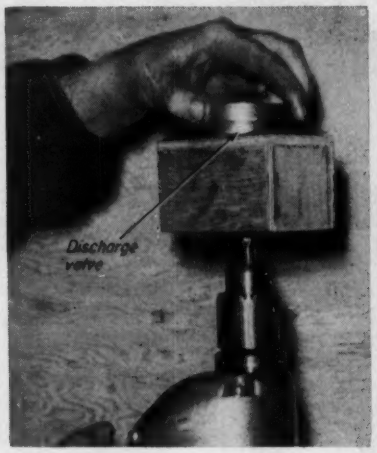
More PRACTICAL IDEAS

Begins on page 128





Handy way to grind air-compressor valves

Here's how I recondition the inlet and discharge valves fitted to air compressors. Strong horseshoe-type permanent magnet is housed in closefitting plywood box, photos. Flat top of box is covered with a medium 80-grit abrasive cloth, held in position by fixed centering disk. Diameter of disk is slightly smaller than inside diameter of double-seat disk valve being repaired. Machine screw passes through magnet's center to form a spindle for driving. Spindle is clamped in jaws of portable electric drill, held vertical in bench vise, as shown.

Tool is custom built because different-size valves demand corresponding-sized components. Make centering disk slightly less thick than valve disk to be ground. That avoids upsetting seat, which might cause grooves in mated surfaces. Thickness of box top is determined by magnet's strength. My magnet, shown, is from old radar set.

Before reconditioning an assembly, I test valve and seat for trueness on a blued surface-plate. Picture of blue shows how much to grind to restore parallel faces, also grade of compound to use.

Valve disk, placed on abrasive cloth, is held in position by magnetic influence. Hold valve seat firmly to prevent turning with the valve. Press lightly while operating electric drill on and off to produce slow turning. To prevent ridges forming on valve and seat, allow seat to take up a slightly eccentric position — working to and from tool's true center. Magnetic influence tends to lock valve and seat, but abrasive cloth provides a grip for valve, and thus keeps it turning. I finish with a No. 3 grade Clover-brand compound for good results on these valves.

F C Lougheed *Victoria, B. C.*

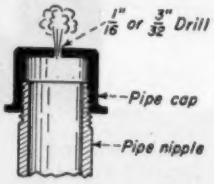
Stop wasteful plant practices

Low power factor can be helped by selecting motors carefully for varied uses. Examples: Favor the synchronous motor and avoid the slow-speed induction motor; they have inherently a low power factor. Use high slip motor for punch presses; this usually allows use of lower horsepower. Loaded with induction motors? Try rearrangement where practical, to average a higher loading. If you can stand the expense, try boosting low power factor by installing capacitors.

Do away with large portable tools when not needed. Don't use larger lights than needed. Don't leave burning light for long periods without use. Don't use strong gas flames or improper mixture. Prevent arcing of switches. Prevent improper tension of belts on the motors. Properly arranged belt or belting has just enough tension so it won't slip under full load.

Other mistakes to avoid are: Failure to instruct properly. Failure to follow instructions properly. Mistakes that mean doing the work over. Using more time than normal to fill in reports.

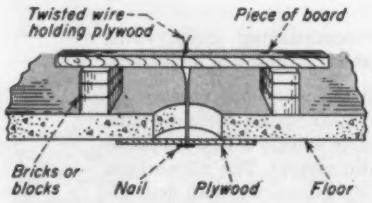
B A Crosson *Cranston, R. I.*



Vent pinch-hits for trap

In absence of impulse traps, which were ordered but not received, we installed drilled caps on ¾-in. drains of our steam lines outside building. These drain lines would have frozen and burst if a small steam flow were not maintained. We drilled 1/6 in. or 3/32-in. hole in ¾-in.-pipe caps, sketch. Then threaded cap and nipple into drain valve. This gave us enough flow to keep drain lines warm without throttling valves and cutting the seats. This trick wastes steam, but it works until a trap can be installed, keeps us in business.

H P Taylor *Bellevue, Neb.*



Quick way to patch concrete floors

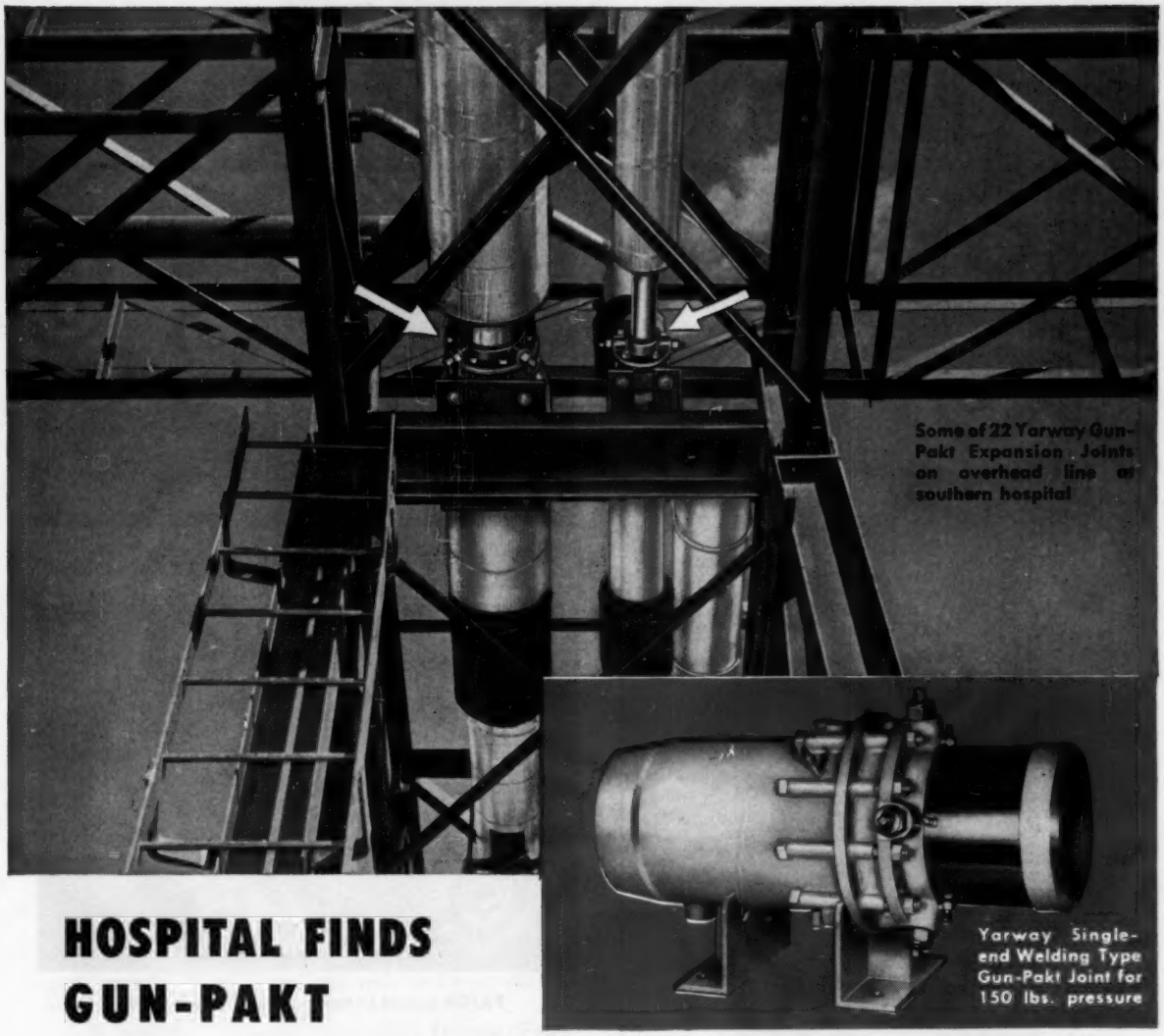
Here's a trick I use to patch holes in concrete floors where a pipe or post has passed through. Use piece of plywood with small hole in center, sketch. Place two stacks of bricks on floor, then a pipe or plank across bricks. Tie together with wire. Most any size hole can be patched this way.

Where wire passes through hole in plywood, wind wire around a nail or steel rod on bottom of plywood form. Patch can be finished to look like old floor. When form is removed, cut wire flush or below surface. Then you can use mortar to cover hole where wire ends are cut. It works well where it's difficult to build a supported form. I have used this method to repair a hole that was 2½x6 feet very successfully.

L E Gile *Kansas City, Mo.*

My biggest boner . . .

Please turn to page 210)



Some of 22 Yarway Gun-Pakt Expansion Joints on overhead line at southern hospital

Yarway Single-end Welding Type Gun-Pakt Joint for 150 lbs. pressure

HOSPITAL FINDS GUN-PAKT *SURE CURE FOR EXPANSION JOINT TROUBLES*

YARWAY Gun-Pakt Expansion Joints are just what the "doctor" ordered for this overhead steam line at a large southern hospital—and he ordered 22 of them!

In institutions, industrial plants and other large steam distributor systems YARWAY Gun-Pakt Joints are growing in popularity.

YARWAY Gun-Pakt slip-type joints give long life—no fatigue failures.

You need *fewer joints per length of line*, with traverses up to 12" single and 24" double.

With Gun-Pakt joints packing may be added as necessary, *under full steam pressure right on the job—no unpacking, no shutdowns.*

There's also *lower pressure load on end anchors* because excessive strains are eliminated.

All these are reasons why it will pay you to "do as the doctor ordered"—look into YARWAY Gun-Pakt Expansion Joints. Write for Bulletin EJ-1914.

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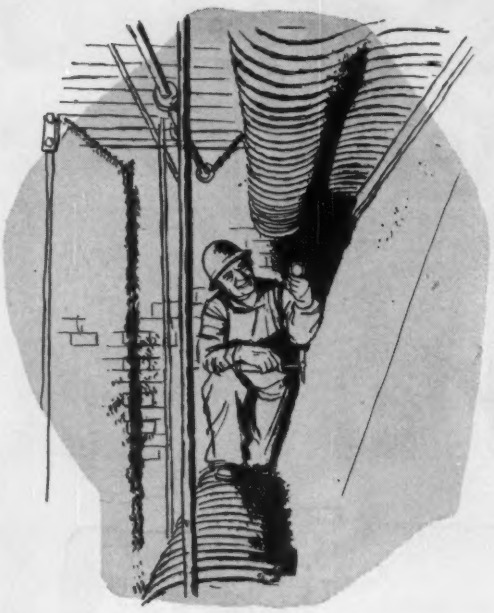
PLANT PROBLEMS... *here is readers'*



The question

What should we look for in buying used boilers?

As plant engineer for a laundry plant, it's my job to supervise expansion of our already overloaded steam services. I figure that if we can add another 10,000 lb per hr to our 100-psi steam system, our plant will be in a good position to handle present steam needs as well as increased demand in the foreseeable future.

We've considered buying new boilers, but find that we can't stretch available funds. So we're now studying the possibility of buying used boilers. Naturally we want to be sure that we aren't cutting corners—saving a few bucks today, only to spend more tomorrow.

I've heard that just because a boiler shell is tight when operating under one set of water conditions, it won't necessarily continue to be tight under another set of conditions. And moving boilers from one location to another can change fixed stresses in boiler, bring on leaks, failure. I'd like readers to give their experience on used boilers. What pitfalls should I watch for?—*KGD, Feb Power*

The answers

BAGGING of the shell in a firetube boiler

PATCH is used to repair bagged firetube boiler

Find out boiler's past history

First of all *KGD* should retain a disinterested *third party* to inspect the boiler both internally and externally. And, most important, he should find out whether the boiler is stamped as an *ASME-National Board* boiler.

Most states require that boilers be built according to the *ASME Boiler Code* and be stamped *National Board*. But if you're in a *Code* state and bring in a non-*Code* boiler, chances are, you'll be limited to 15-psig operation.

The disinterested third party can be your present boiler insurance carrier who has representatives in all parts of the country. He will inspect the boiler for a reasonable fee.

Past history is important because it gives an indication of what might be wrong with the boiler. Here are some likely trouble spots to watch out for:

Scale trouble. Scale in a watertube boiler can cause tube blisters that result in thinning and weakening of the tubes. It may also obstruct tubes, thereby interfering with circulation. In a firetube boiler, scale can cause overheating and bagging of the shell next to the fire, see photo at top. *KGD's* prospective boiler may have bagged and been patched as shown in the lower photo.

Low water. This condition, in either watertube or firetube boilers, may cause tube overheating, distortion and leakage at the seats. Result is weakening of tubes due to stresses beyond metal's yield point. Repeated rolling of

leaking tubes may cause further distortion. When this happens, further rolling is useless.

Corrosion. If boiler *KGD* plans to buy has been used in an area where water quality is a problem—and where water-treatment methods have been lax—the boiler may be corroded. After a short operating period, leakage may start at corroded areas. Tubes may even rupture.

Replacement by a larger-capacity boiler may be the present owner's only reason for wanting to sell his unit. No matter how reliable the owner is, he will naturally be reluctant to spend money or time to prepare his boiler for an internal and external inspection. But a hydrostatic test is particularly important. And *KGD* should insist on it.

If the unit is OK in all other respects, moving it from one area to another isn't a serious problem.

Don't forget: No matter how good the boiler is, if it isn't the right size, it's a poor investment. So it pays to check with the boiler manufacturer to find out the unit's continuous rating and any other available info.

E D Dow Jr, *Mechanical Engineer* *Barberton, Ohio*

Has *KGD* considered leasing?

Many plants have found themselves in circumstances similar to *KGD's*. They don't want to tie up money if they can find another way out. Such companies often make agreements with firms who buy new boilers and lease them to users.

Sure, the user pays more for leasing the equipment. But compared to trying to find a used boiler to meet specific needs, it has several advantages. By leasing, *KGD* gets a modern boiler that's tailored to his requirements. It packs more capacity in less space and runs at higher efficiency. Manpower and maintenance costs are also less.

L C Martin *Tacoma, Wash.*

Beware of the 'bargain'

Second-hand boilers can lead long, useful lives when carefully chosen and maintained. But *KGD* will do well to beware of the "bargain" with a new coat of paint. Here's how to make sure of getting a good used boiler:

First, equipped with coveralls, flashlight and hammer, give the unit a thorough goingover—on both fire side and water side. Look for signs of metal wastage, such as grooving, pitting, embrittlement, as well as traces of leakage at tube sheets and riveted joints. Check for scale deposits. In many boilers small leaks are sealed off by scale. A change in water conditions can loosen scale, cause leakage.

After checking fire side for blistered tubes and furnace bagging, look for signs of repair work and request a hydrostatic test. Also go over the control system and any auxiliaries involved.

Settle with the vendor on price, guarantees—if any—and responsibility for delivery. If in doubt on the contract, get help from your legal department.

Once the boiler is on your own site, get out the coveralls and flashlight again. Give the unit another thorough inspection and another hydrostatic test to check for damage in transit. It'll pay to get an experienced boiler-moving contractor who'll take responsibility for hauling damages.

A R Peck *Dayton, Ohio*

Insurance company's inspector can help

Before buying a used boiler it's smart to have an insurance inspector check it. This inspection—internal and external—is made at the seller's site. The inspector should also witness a hydrostatic test at 1½ times the unit's rated pressure. Basically, the inspector is in the same position as a bank representative who checks on a home before granting a mortgage.

The insurance company then sends the prospective buyer a written report stating condition of the boiler. While the report isn't a guarantee, it does tell whether the unit is acceptable for insurance at a specified pressure.

J McDonnell *Marshfield Hills, Mass.*

Want free consulting service? Send in your design and operating headaches to us. We'll give readers a whack at them.

Turn page for info on insulation-resistance testing

More PLANT PROBLEMS

Begins on page 134

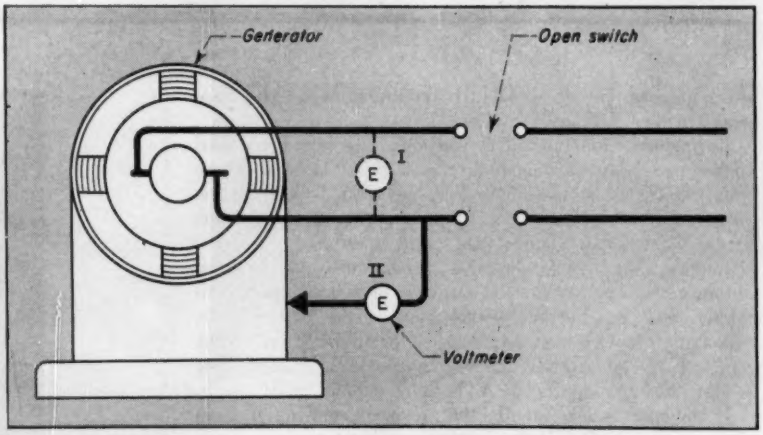
The question

Why does insulation-resistance test give almost zero readings?

The turbine-generators in our plant have operated normally for many years at full load. But plant records show that repeated insulation resistance tests of field-rotor windings give us readings close to zero. Naturally, the condition has us wondering.

Can readers tell us if this is a dangerous condition? What are the hazards of continued operation as is? What is a recommended minimum resistance reading? What's the best way to measure it? Is a megohmmeter test OK?—*CRW, Feb Power*

The answers



How to figure, check insulation resistance

After a generator is placed in service, conditions that affect insulation resistance include: cleanliness, moisture, temperature and damage to the insulation. If *CRW* gets a set of resistance readings, on periodic tests, that are progressively lower, he can expect trouble—even if the actual readings are greater than recommended minimums. On the other hand, if regular testing shows values that remain constant, he has no cause for concern—even if resistances are somewhat less than recommended minimums.

The "one-megohm rule" is a yardstick that can be used to set a lower limit of allowable insulation resistance for equipment operating at 1000 volts or less. This rule allows one megohm per 1000 volts. For generators of any size, *CRW* can use the following:

$$R = \text{rated voltage} \div (\text{rated kva}/100 + 1000)$$

where R = minimum insulation resistance at 75 C, recommended by the American Institute of Electrical Engineers.

The sketch above is a typical hookup for testing the insulation resistance of a generator. In this setup *CRW* can figure insulation resistance from the following formula:

$$R_x = R_v(E/E_1 - 1)$$

where

R_x = insulation resistance, ohms
R_v = voltmeter resistance, ohms
E = source potential, volts
E_1 = voltmeter reading, volts, when connected in series with insulation being tested

If *CRW* has to measure high resistance values he can use a megohmmeter. These instruments can read up to several thousand megohms.

H B Wayne *Brooklyn, N. Y.*

Resistance readings can be misleading

Insulation-resistance tests are made to determine the condition rather than the quality of insulation. Readings can be misleading if the comparison is based strictly on "ohm" values. *CRW* says he gets readings close to zero. On a megohmmeter this is a moot point. How much is close to zero?

Most important operating hazard with low insulation-resistance readings is the possible breakdown and outage that could take place during peak-load periods. And you can't discount the personal-safety angle either.

If the reading is substantially lower than the value read when the machine was new, then it's time to call in the maintenance people. Grease, dirt or carbonized material could be causing the low reading. Also, be sure to check the megohmmeter's calibration.

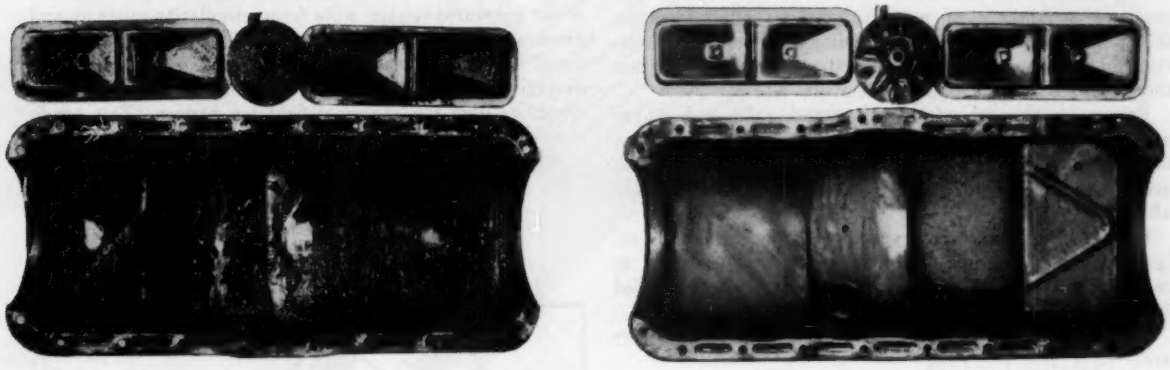
Minimum figure for field windings is one megohm plus, at 75 C. Using a megohmmeter, be sure test time is long enough to give a stable reading. With the voltmeter method be sure meter resistance is great enough to give a reading. Machine should be at the same temperature for each successive test.

J F Bates *Queens Village, N. Y.*

For more on resistance testing and new problems, turn page

PROOF POSITIVE...

of SINCLAIR Diesel Oil Superiority!



This is actual photographic proof of the superiority of Sinclair Diesel Lubricants. On the left is a truck engine sump in which an ordinary oil was used. The clean sump on the right reflects conditions when a Sinclair Diesel Oil, SUPER TENOL, was used. This same top quality lubrication performance can be expected from all Sinclair Diesel Oils . . . *because Sinclair has the exact oil to match your engine's requirements!*

Sinclair RUBILENE® – These high viscosity index oils, refined by Sinclair's famed Phetone Process, have a long history of outstanding performance and are extensively used in stationary Diesel power plants today.

Sinclair RUBILENE HD – These high viscosity index oils contain additives which provide excellent detergent – dispersant properties, oxidation resistance, bearing corrosion prevention and anti-foam qualities. They are especially suitable for stationary Diesels as well as the higher speed Diesels used in industrial plants.

Sinclair GASCON®–These naturally detergent, straight mineral oils are recommended for slow, medium and high speed Diesels where carbon deposits, engine cleanliness and easy, low temperature starting is important.

Sinclair GASCON HD – Heavy duty detergent type oils compounded with selected additives to provide extra detergent dispersant properties, bearing corrosion prevention, oxidation resistance and anti-foam characteristics.

Sinclair TENOL®, SUPER TENOL and TENOL EXTRA –A series of heavy duty, detergent–dispersant type, high viscosity index oils refined by the Sinclair Phetone Process. Recommended for all high speed automotive fleet Diesel engines, and for some engines of late design in stationary, portable and marine service. All three series contain varying degrees of additive concentrations necessary to give outstanding performance no matter what the service condition under which your Diesel operates.

For further information about Sinclair's trouble-proof Diesel lubricants, see your Sinclair Representative, or write Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

DIESEL OILS

More PLANT PROBLEMS

Begins on page 134

Condition may not be serious

Even though *CRW's* readings are close to zero, the condition may not be serious.

For field rotors, insulation resistance tests indicate the presence or absence of moisture, dirt or other elements that tend to reduce resistance readings. A study of variations in resistance over an extended period shows whether the condition is becoming progressively worse.

Resistance changes with temperature, relative humidity and cleanliness. Also, larger rotors have a lower resistance to ground than smaller ones. Since *CRW's* unit has been giving good operation for many years, the machine is probably quite safe.

Generator manufacturers specify definite insulation resistance ranges. By following variations that show up in regular tests an operator can decide whether he's headed for trouble.

Two common methods for measuring insulation resistance are:

1. A dc voltmeter and a dc source of about 500 v. Meter resistance, R_v, should be about 100 ohms per volt. Take two readings. One across the supply terminals is E. One to ground is V_r. Insulation resistance R, is:

$$R = R_v\,(E - V_r)/V_r$$

2. Direct-reading megohmmeter gives a quick and accurate resistance reading within specified operating ranges.

C O VON DANNENBERG *Brooklyn, N. Y.*

Continuous records are important

CRW's problem shows the value of keeping systematic records of insulation data. One reading, in itself, has no great significance. The important thing is to measure and record the change in resistance over a period of years. Gradually decreasing values show up deteriorating insulation.

Some years ago I had an experience with a fine old 500-kw generator. After 30 years of service, during which time the machine had been well maintained, resistance dipped below 0.5 megohms. We decided to overhaul. The unit was completely dismantled, thoroughly cleaned and all insulation revarnished. When put back in service, the generator showed values greater than 100 megs. It has now been in service over 40 years and is still going strong. Overhaul work was done by the manufacturer.

My advice to *CRW* is to overhaul his generator as soon as his schedule permits. With the resistance readings he is getting at present, a prolonged damp spell could introduce enough moisture to cause failure. If he didn't have a history of consistently low readings, I would recommend that he try overhauling on an emergency basis.

W J STEINERT *Fresh Meadows, N. Y.*

Insulation failure can be dangerous

A series of insulation-resistance tests that show a decreasing set of figures is a fair warning of hazardous conditions. Some possible results of insulation failure in the field winding are: (1) Partial short circuit of the field causing increased field current and overheating. (2) Progressive failure of the insulation due to overheating. (3) Burning of rotor iron at the point of insulation failure. (4) Distortion of the field flux pattern due to a partial short circuit in the winding. When this happens *CRW* will get distortion of the generated-voltage wave form, circulating currents and overheating. (5) Unbalanced magnetic forces due to unbalanced field flux. Result is vibration and possible mechanical damage to the machine. (6) Hunting and loss of synchronism from the abnormal field-flux pattern. This condition also results in circulating currents and low-voltage.

N SAVAGE *Oak Park, Mich.*

YOUR MAY PROBLEMS

1 Why does soot blowing erode boiler tubes?

I'm chief engineer in a boiler plant that's equipped with three relatively new 25,000-lb-per-hr coal-fired boilers. Operating pressure on these units is 250 psig. Coal is burned on spreader stokers.

Recently, during one of our regularly planned boiler inspections, we noticed that the walls of boiler tubes in the first gas pass had thinned out in several spots. We believe the steam-operated soot blowers that clean these tubes have something to do with the erosion condition.

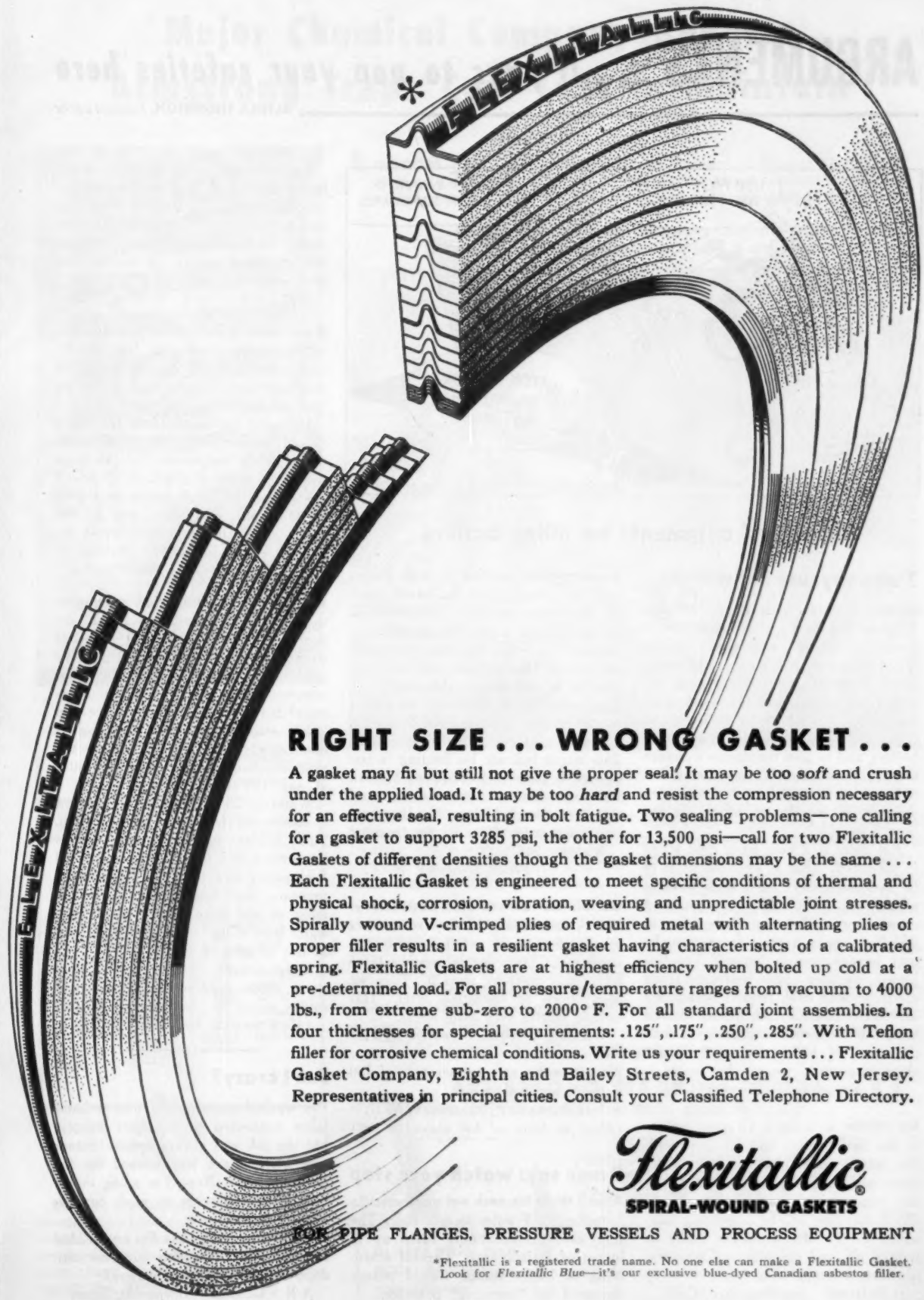
Naturally, we plan to replace these tubes. But we don't want to face the same problem all over again. We'd like to get at the root of our troubles. Can *Power* readers tell me how to track down the trouble? Are soot blowers the culprit?—*WGW*

2 How can we estimate effect of changed steam conditions?

Our industrial power plant installed a 7500-kw turbine about five years ago. Original steam conditions for this machine were 400 psig, 750 F at the throttle and 10-psig backpressure. Exhaust steam is used for heating and process.

Change in our process now requires 30-psig steam. Naturally we can't expect to carry the original electrical load on our turbine-generator. But we would like to know the effect of this planned change. Can we handle process needs in a more economical way? Will we run into trouble on our turbine operation? We'd like to get ideas from *Power* readers.—*CSK*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.



RIGHT SIZE . . . WRONG GASKET . . .

A gasket may fit but still not give the proper seal. It may be too *soft* and crush under the applied load. It may be too *hard* and resist the compression necessary for an effective seal, resulting in bolt fatigue. Two sealing problems—one calling for a gasket to support 3285 psi, the other for 13,500 psi—call for two Flexitallic Gaskets of different densities though the gasket dimensions may be the same . . . Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a pre-determined load. For all pressure/temperature ranges from vacuum to 4000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

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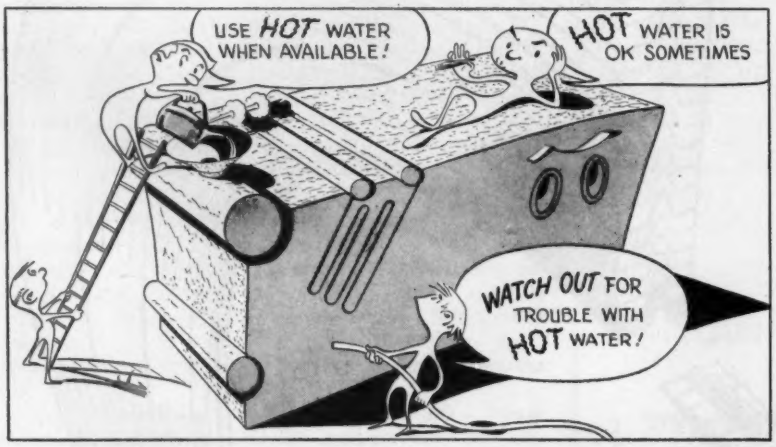
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

ARGUMENTS . . . *it pays to pop your safeties here*

ALTHEA THORNTON, *Assistant Editor*



Readers' comments on filling boilers

7 men say: use hot water

Usually I agree with Reader Atwell, January Arguments. Our plant has 16 watertube boilers, aggregating nearly 2-million-lb-per-hr capacity and using 240-F feedwater. For many years we have filled boilers with hot water without harm. We arbitrarily limit rate of filling to 50 gpm to avoid robbing other boilers, and to give the drums a chance to warm uniformly. We have found that it is safe to use feedwater of this temperature in our drums, which are not over 3 in. thick.

But there is a time when cold water is preferred. That is when boiler is to be hydrostatically tested after welding repairs on tubes. When a man must crawl over or between bare tubes at 240 F to make a close inspection, he may be dangerously burned. For this reason, we keep spare feedwater treaters filled with cold, treated water. We save many hours by not having to wait until boiler is cool enough for a man to enter. If boiler does not require close inspection, we use hot water.

A E PRITCHARD *Jennings, Mo.*

My advice is to back up your boilers to the feed heaters and fill them with the hottest water you can get. True, there will be minor stresses set up by the temperature change from 75 to 235 F, but they will be as nothing compared to the stresses when boiler is lighted off, and pressure and temperature raised to operating level.

D DEHUFF *San Francisco, Calif.*

Recommended practice is to fill boilers with hot, treated and deaerated water in preference to cold raw water, if this is done in a prudent manner.

I have done this for eight years with no trouble. But I take four hours or more to fill a boiler to steaming level. The boiler holds 27,000 lb of water; so rate of flow is about 7000 lb per hr.

Atwell uses hot water to save time. This might indicate his feeding is fast enough to cause thermal stress. Modern watertube boilers can take more of this than Scotch boilers, but the practice is not good. Why ask for trouble?

WALTER STEINERT *Fresh Meadows, N. Y.*

We fill our boilers with feedwater at 214 F, and adjust the flow so it takes four or five hours to fill for a hydrostatic test. After test is over we leave boiler full until we need it. Then we blow down to operating level. This method causes very little stress.

WILLIAM OTHMER *Brooklyn, N. Y.*

We use water at a temperature of 180 F to fill our boilers.

A H PARKER *Peterborough, N. H.*

(*More in favor of hot water, p* 190)

5 men say: watch your step

Atwell sticks his neck out unnecessarily by using 235-F water to save time. The time saved is eventually eaten up in increased maintenance. Careful scheduling of boiler outage should reduce the need for "hurrying" a boiler.

Large temperature differences in any boiler cause rapid and unequal expansion of tubes and drums. This can lead to failure of tube joints, drum-to-casing seals, and sometimes, with refractory faced waterwalls, to extensive brick-work damage.

A R PECK *Dayton, Ohio*

If hot water is used to fill a cold boiler, be extremely careful to feed slowly, and open the boiler vent valves so the resultant flashing into steam builds up no pressure.

I suggest that water to fill the boiler should be not more than 75 F above or below the temperature of the drum where the water is admitted. If Atwell has to use the 235-F water, he should dilute it with cold water, and fill the boiler slowly to be sure to avoid expansion strains or uneven heating.

M J BLACKWELL *Saltville, Va.*

A cold boiler generally has a temperature anywhere from 70 to 100 F, depending on amount of heat absorbed from adjacent boilers and settings. We agree that there is little chance of stressing boiler metal from the differential between metal temperature and 235-F water, especially if filling is done slowly. We see no gain in the practice, though, and believe feedwater at, say, 190 to 210 F is better.

Water at 235 F flashes the moment it enters the feed pipe in the drum. This sudden flashing causes water-hammer action that stresses internal feed piping and threads. Flash steam prevents easy liberation or displacement of air from boiler vents. True water level is hard to determine because of the amount of bubbling.

Water-hammer stress when flash steam enters superheater header could cause stress in superheater flooded

(*More against hot water, p* 190)

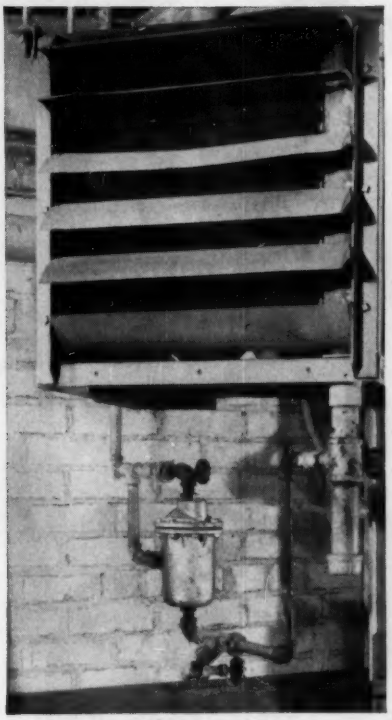
Am I crazy?

I've washed superheaters with a hand lance connected to hot-water supply, but the job was always messy. Steam soot blowers are also hooked up for washing tubes. Next, I'm going to try air-puff soot blowers to wash our superheaters.

Some of our boys say I'm crazy. Am I? Can POWER readers give me any dope on cleaning superheaters?

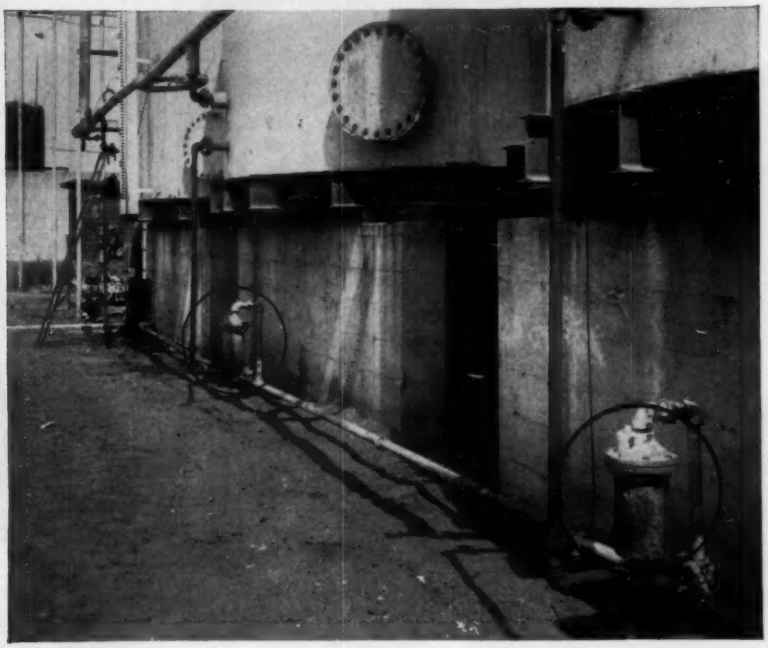
A R S GUNNER *Beaumont, Texas*

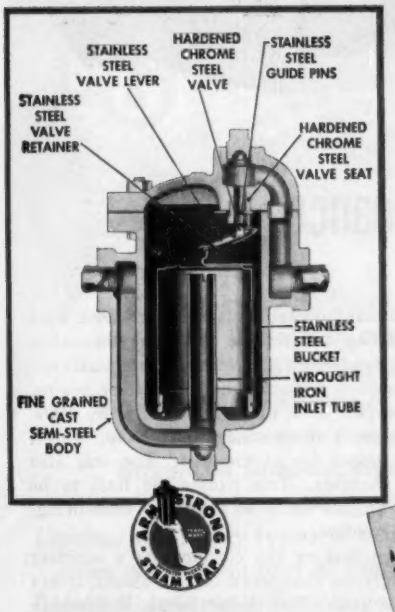
Major Chemical Company Reports Armstrong Traps Cost Less to Maintain



INDOORS—Mr. George Gentes, Works Manager at Hooker Electrochemical Co., Tacoma, Wash., says, "We feel that we get excellent service with Armstrong traps. We have been using them for about 10 years."

OUTDOORS—these Armstrong traps give year 'round service at Hooker's big Tacoma plant.




STAINLESS STEEL VALVE LEVER
HARDENED CHROME STEEL VALVE
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FINE GRAINED CAST SEMI-STEEL BODY
ARMSTRONG STEAM TRAP

Trap's Lot is a Hard One. A steam trap takes a lot of punishment. On some jobs it may operate *1,000,000 times a year*. The parts are subjected to dirt, scale and corrosive substances, high temperatures and the erosive action of the condensate.

Armstrong's Take it Well. Armstrong traps endure these conditions remarkably well. In reporting on less trap maintenance since installing Armstrong traps Mr. George Gentes, Works Manager of Hooker Electrochemical Company's plant at Tacoma, Washington stated:

"We get excellent service . . . our trap maintenance cost is very low."

Others Agree. More Armstrong customers mention low maintenance than any other single benefit. That means more than low repair costs. It means freedom from leaky traps that waste steam, freedom from faulty traps that slow up production —freedom from *trouble*.

A Suggestion. Send for the Armstrong Catalog listed below or, better yet, call your local Armstrong Representative or Distributor —he's exceptionally well qualified to help you improve your trapping situation.

ARMSTRONG MACHINE WORKS
812 Maple Street • Three Rivers, Michigan

Simple, dependable Armstrong traps mechanisms have only two moving parts —bucket and lever. Design, materials and workmanship in low and medium pressure traps identical to that of traps for 900 lbs., 900°F service!

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44-PAGE STEAM TRAP BOOK—Send for yours —no obligation.

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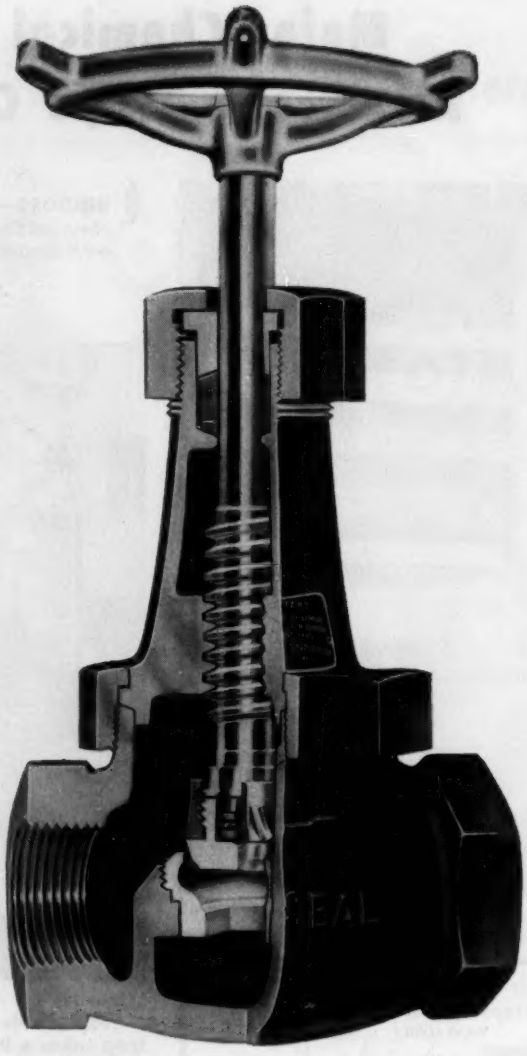
SPINNING DISK, caused by directing flow against vanes in side of disk as valve closes, keeps contact surfaces lapped



HOW TO cut down valve maintenance

► To KEEP a globe valve tight, you must have a disk-to-seat seal between the disk and seat. This isn't always easy to do because: (1) Particles of scale or other foreign matter may be caught between the seat and disk when valve is closed. (2) Coating of foreign matter may accumulate on closing surfaces of disk and seat when valve is left in open position for long periods. (3) Wire drawing (erosion) of closing surfaces may be caused by abrasive particles carried by high-velocity gases or fluids while valve is in throttling or cracked position.

One way to tackle these problems is to vary the hardness, toughness or type of materials; also to use greater area of contact between seat and disk. Valve shown uses a new approach. Here disk spins rapidly at moment of closure. Claim is that centrifugal force generated by spinning action throws off any scale or other foreign particles, thus preventing them catching between disk and seat. Manufacturer further claims that as disk touches the seat, it spins rapidly. This polishes or laps the two surfaces together, creating a complete metal-to-metal contact. Note: Disk does not spin in the throttling range. The spinning stops after one complete turn of handwheel, according to manufacturer. This is the cracked position or point where throttling begins.

Valve has a dual-purpose seat, which is actually two seats. Closure seat is at bottom and throttling seat at top. Throttling is done on the upper lip of the seat. The seat also acts as a reversing chamber. This causes the fluid to be deflected against the turbine vanes of the rotor, thus bringing about the spinning action.

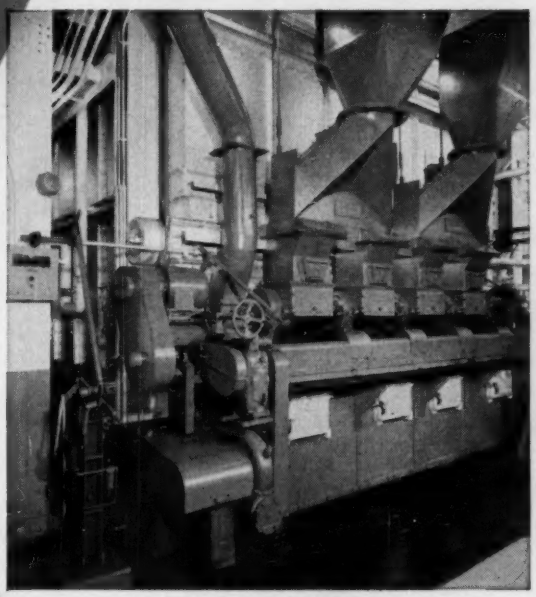
Line contact is from making the closing seat a segment of a circle. Accordingly, as chamfered disk is closed, it has line contact with the seat. This helps break up foreign coating, which may accumulate when valve is left open for long periods. Claim for separate throttling seat is that line contact can be made without damaging closure seat by wire drawing. Disk has ball bearing, as shown in photo above.

—Courtesy, Gyroseal Valve Division, Richmond Foundry & Mfg Co, Richmond, Va.

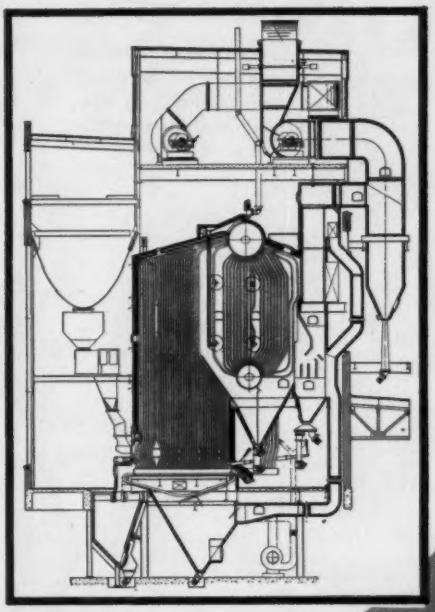
Detroit RotoGrate Stoker

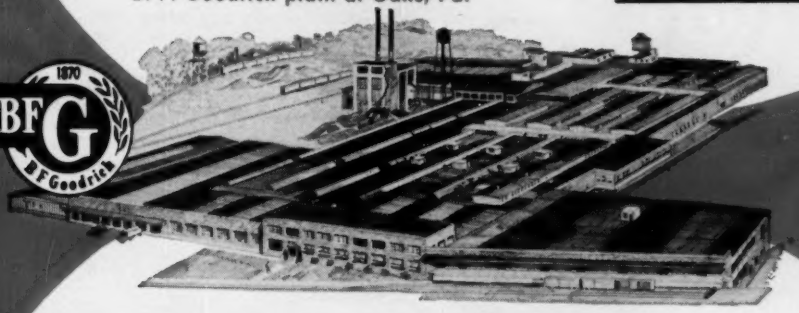
SELECTED FOR TIRE PLANT

The B. F. Goodrich Company, Oaks, Pa.



Detroit RotoGrate Stoker in
B. F. Goodrich plant at Oaks, Pa.





This Detroit RotoGrate Stoker is installed with a Wickes two drum Steam Generator, capacity 115,000 lbs. per hour at 300 psi and 440° F. Design is based on using 350° F preheated air, when burning Fairmont District West Virginia coal. This is part of an expansion program at this plant. Detroit RotoGrate is an advanced spreader stoker with specially designed overlapping grates that move slowly forward, discharging ash at the front. Any Bituminous coal or Lignite, and many types of refuse are successfully burned. High burning rates per square foot of grate and exceptional flexibility make this stoker popular. Detroit RotoGrate will save you money—improve your operation.

DETROIT STOKER COMPANY
GENERAL MOTORS BLDG.—DETROIT 2, MICH.
District Offices in Principal Cities • Works at Monroe, Mich.

DETROIT SINCE 1898 STOKERS

7108

BASICS . . . *bringing engineering theory down to earth*

HOWARD KALLEN, *Associate Editor*

Figuring pressure drop, flow rate, pipe size

To figure	Steps
Pressure drop when you know flow rate, pipe size, upstream pressure. (Several pipe sizes may be assumed to get a range of pressure drops)	1. Find viscosity from graph of temperature vs viscosity for different fluids 2. Find Reynolds number from $R = 6.32W/dv$ 3. For viscous flow (R less than 1200), figure pressure drop from $\Delta p = 0.000273QLv/d^4$ 4. For turbulent flow (R greater than 1200), find friction factor from graph of R vs f for different pipe materials and sizes. Then figure pressure drop from $\Delta p = 0.00000336fLW^2\bar{V}/d^5$
Flow rate when you know pipe size, upstream pressure, pressure drop	1. Estimate reasonable velocity and find corresponding flow rate from $W = vd^2/0.0509\bar{V}$ 2. Find viscosity from graph of temperature vs viscosity for different fluids 3. Figure Reynolds number from $R = 6.32W/dv$ 4. For viscous flow (R less than 1200) figure actual flow rate from $Q = \Delta pd^4/0.000273Lv$ 5. For turbulent flow (R greater than 1200) find friction factor from graph of R vs f. Then figure flow rate from $W = (\Delta pd^5/0.00000336fL\bar{V})^{1/2}$. If W from step (1) doesn't equal W from step (5), assume another velocity and repeat steps (1), (3), (5). Three trials should pinpoint correct flow rate
Pipe size when you know flow rate, initial pressure, maximum allowable pressure drop	1. Estimate reasonable velocity and find corresponding pipe size from $d = (0.0509W\bar{V}/v)^{1/2}$ 2. Find viscosity from graph of temperature vs viscosity for different fluids 3. Figure Reynolds number from $R = 6.32W/dv$ 4. For viscous flow (R less than 1200) figure required minimum pipe size from $d = (0.000273LQv/\Delta p)^{1/4}$ 5. For turbulent flow (R greater than 1200) find friction factor from graph of R vs f. Then check to see if actual pressure drop falls within maximum allowable pressure drop from $\Delta p = 0.00000336 fLW^2\bar{V}/d^5$. If Δp is greater than maximum allowable, assume a lower velocity and refigure d in step (1). Repeat steps (3) and (5) to make sure the new pipe size from (1) yields an allowable pressure drop

Symbols

R = Reynolds number	f = friction factor
Q = flow rate, gpm	L = pipe length, ft
W = flow rate, lb per hr	$\bar{V}$ = specific volume, cu ft per lb
d = pipe ID, in.	Δp = pressure drop psig
v = absolute viscosity, centipoise	v = velocity, fps

FLUID FACTS—9

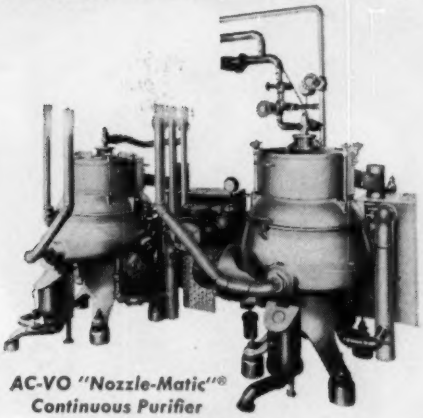
Your guide to easy flow-condition figuring

► TABLE ABOVE pinpoints some practical applications of the fundamentals we've talked about thus far.

In tackling problems, you'll often have to assume a reasonable figure for flow velocity. Piping and equipment manufacturers frequently list such data in their catalogs. Or specific conditions in your plant may place limits on velocity. But don't forget that specifying flow is just as much an economic problem as it is a technical one. And final answers may well hinge on cost of piping, pumping power.

NOW...

Diesel Operation on Heavy Fuel Is Simply a Question of Which De Laval!...



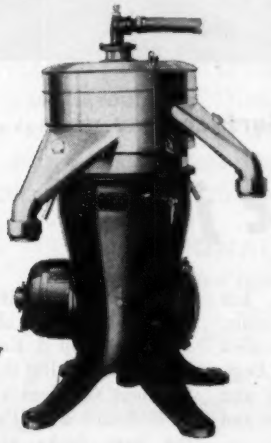
AC-VO "Nozzle-Matic"® Continuous Purifier

There is no longer any doubt as to both the *economy* and the *practicality* of burning residual fuels in diesel engines.

And, today, there is also no question of getting the *precise* centrifugal purifier to prepare heavy fuel for any particular set of circumstances . . . *De Laval* provides three different types. Each type has proved its efficiency and freedom from trouble in many installations, both land and marine.

Recommended capacities of each type are given below. Complete details on request . . . without obligation!

PX 209.00 Self-cleaning Centrifuge



Standard Purifier

RECOMMENDED CAPACITIES—G.P.H.

VIS.	TEMP.	AC-VO	PX 209. F	STANDARD PURIFIER
500	180° F	1200	600	300
700	180° F	1100	550	275
1700	180° F	660	330	165
2500	180° F	560	280	140
4000	190° F	440	220	110
5000	200° F	300	150	75

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heavy fuel oil purifiers

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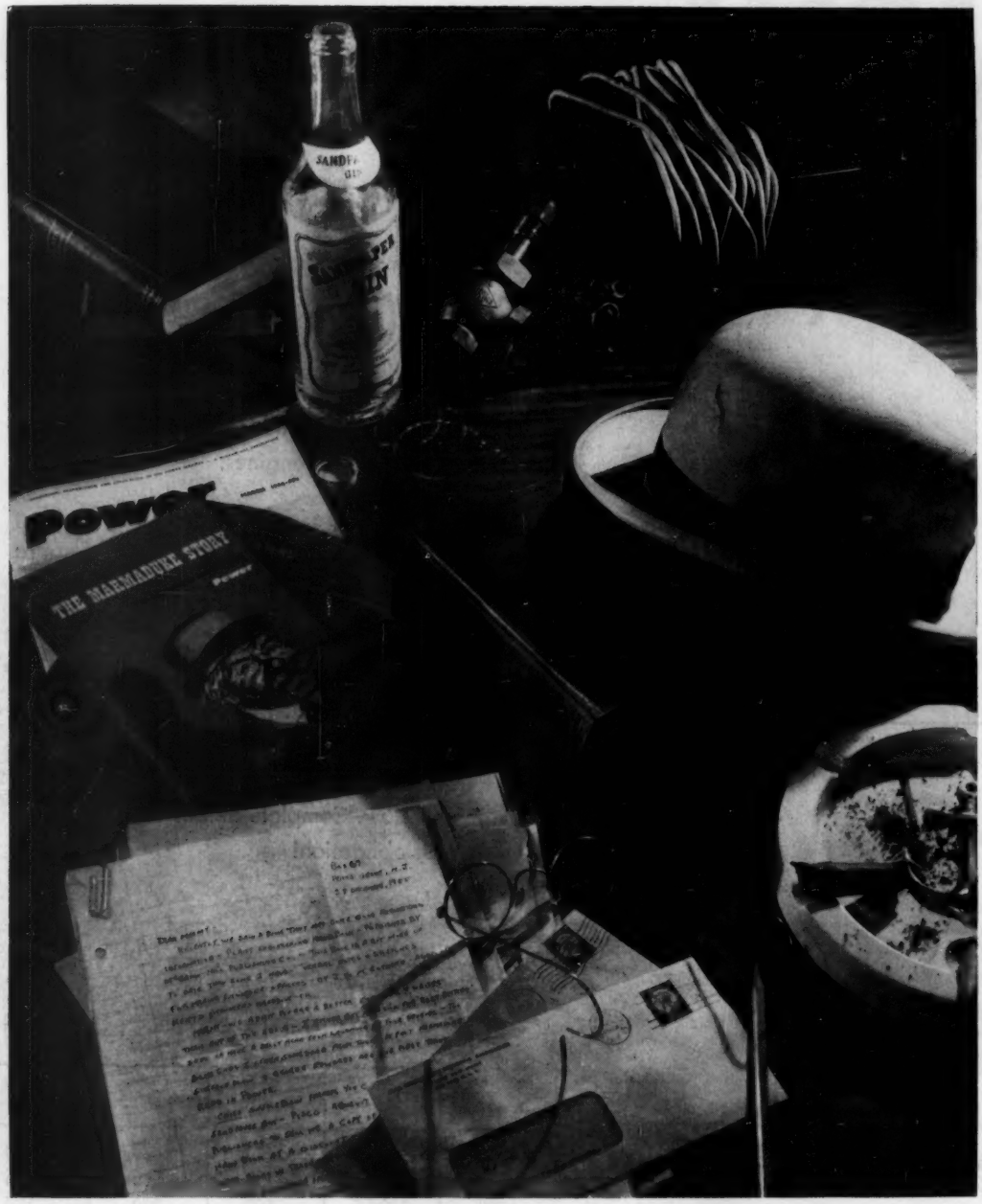

From this busy desk comes the 100th Surfaceblow yarn . . .

Marmy's magic juice

► ONE HUNDRED is a magic number for most of us. As kids, there was the first time we counted to 100, the time we saved 100 pennies, the time we got 100 in school. Then we remember the first time we earned $100.

Well, this is the one hundredth time that Marmaduke Surfaceblow, that unpredictable consulting engineer, has sounded off in print. His first rumble, entitled "Haywire Happy," appeared in the February 1948 *Operating Engineer*. That magazine—lock, stock and barrel—is now the Plant Operation and Maintenance Section of POWER.

The other evening I again climbed the rickety old stairs leading to Marmy's dingy office above O'Houlihan's Machine Shop & Engine Works—as I have so often. But the door was locked. My next stop was a few blocks away at Bedlam's Bent Propeller Bar along the busy docks around the corner.

(*Continued on page* 212)

The Power Plant Engineer Said:
"I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined?

ENGINEER: I wouldn't know—only worked here seven years. *

* You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

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Montgomery — Alabama Machinery & Supply Co.
Noland Company, Inc.
Selma — Selma Foundry & Machine Co.

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Tucson — Arizona Hardware Co.

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Maywood — M. E. Gray Company
Redding — Gerlinger Steel & Supply Co.
San Diego — Gould Hardware & Machinery Co.
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The Wellington-Kincaid Co.
Danbury — Winfield S. Holman, Inc.
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Greenwich — Futty & Company, Inc.
Hartford — The Callahan Company
Lasher Supply Co., Inc.
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Thomas Trant & Bro., Inc.
Ward & Hausser
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New Haven — The C. S. Mersick & Company
New London — Hansen Supply Co.
Norwalk — County Supply, Inc.
Norwich — The Anderson Supply Company
Putnam — Rawley Plumbing Supply, Inc.
Stamford — Connecticut Plumbing Supply Co.
Glauber, Inc.
Waterbury — M. J. Daly & Sons, Inc.

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Fort Lauderdale — Duncan-Edward Company
Jacksonville — Farquhar Machinery Co.
Noland Company, Inc.
Miami — Railey-Milam, Inc.
Orlando — Hughes Supply Inc.
Pensacola — May Supply Co.
St. Petersburg — Gulf Coast Industrial Supply Co.
Tallahassee — Marbut Company
Tampa — Noland Company, Inc.

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Albany — Georgia Hardware & Supply Co.
Atlanta — Beck & Gregg Hardware Co.
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Grinnell Company, Inc.
Noland Company, Inc.
J. M. Tull Metal & Supply Co.
Augusta — Noland Company, Inc.
Richmond Supply Co.
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Columbus — Columbus Plumbing, Heating & Mill Supply Co.
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Rome — Battey Machinery Co.
Valdosta — Marbut Company
Whitehead Hardware Co.

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Chicago — Chicago Tube & Iron Company
James B. Clow & Sons
Great Lakes Supply Corporation
Fred C. Kramer Co.
Miller Supply Company
Danville — Inland Supply Company
DuQuoin — DuQuoin Iron & Supply Co.
Peoria — Wilkins Pipe & Supply Company
Rock Island — American Rad. & Std. Sanitary Corp.
Rockford — D & F Supply Company

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Anderson — May Supply Company
Aurora — Aurora Supply Company
Evansville — Plumbers Supply Corporation
Fort Wayne — The National Mill Supply Company
Indianapolis — Plumbers Supply Corporation
Kokomo — The Main Supply Company
Lafayette — Biggs Pump & Supply Co.
Marion — Liniger Company, Inc.
Richmond — H. R. Smith Supply Co., Inc.
South Bend — The South Bend Supply Company
Terre Haute — Mechanical Suppliers, Inc.

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Des Moines — A. Y. McDonald Mfg. Co.
Plumb Supply Co.
Dubuque — A. Y. McDonald Mfg. Co.
Marshalltown — Glick Supply Company
Sioux City — Wigman Company
Waterloo — Winterbottom Supply Co.

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Hopkinsville — Cayce Mill Supply Company
Lexington — Plumbers Supply Company
Louisville — Belknap Hdwe. & Mfg. Co.
Neill-LaVielle Supply Company
Plumbers Supply Company

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Monroe — Murco, Inc.
New Orleans — Edgar Murray Supply Co.
Shreveport — Monsco Supply Co.

MAINE

Bangor — R. B. Dunning & Co.
Portland — W. L. Blake & Co.

MARYLAND

Annapolis — Thos. Somerville Company
Baltimore — The Taylor Supply Company
Cumberland — Tri-State Mine & Mill Supply Co., Inc.
Hagerstown — Foltz Manufacturing & Supply Co.

MASSACHUSETTS

Attleboro — Reardon & Lynch Company, Inc.
Boston — Atlantic Pipe & Supply Co., Inc.
Conley Supply Co., Inc.
Pierce-Perry Co.
Brockton — Corcoran Supply Co. of Brockton, Inc.
Cambridge — Boston Pipe & Fittings Co., Inc.
Metropolitan Pipe & Supply Co.
R. C. Sullivan Company
Fall River — Corcoran Supply Co. of Fall River, Inc.
Gardner — Royal Supply Company
Holyoke — The Holyoke Valve & Hydrant Co.
Hyannis — R. B. Corcoran Co. of Hyannis
Lawrence — Bride, Grimes & Co.
Lowell — Middlesex Machine Company
Lynn — The Bourneuf Corporation
New Bedford — Babbitt Steam Specialty Co.
Peabody — Boyle Machine & Supply Co.
Jefferson Industrial Supply, Inc.
Pittsfield — Berkshire Mill Supply Co.
South Boston — Charles D. Sheehy, Inc.
Springfield — Charles Millar & Son Co.
Westfield — Warner Supply Co., Inc.
Worcester — Washburn-Garfield Co.

MICHIGAN

Battle Creek — Kendall Hardware Mill & Supply Co.
Benton Harbor — Brammall Supply Co.
Detroit — The Coon DeVisser Company
Flint — A. P. Engelhart & Co.
Grand Rapids — Hayden Supply Co.
Iron Mountain — Wittock Supply Co.
Jackson — The Smith Winchester Co.
Kalamazoo — Kendall Hardware Mill & Supply Co.
Lansing — The Michigan Supply Co.
Muskegon — B. R. Fisher Co.
Saginaw — Reichle Supply Co.

MINNESOTA

Duluth — Duluth Plumbing Supplies Company
Minneapolis — Central Supply Co.

MISSISSIPPI

Jackson — Harper Foundry & Machine Co.
N. O. Nelson Co.
Meridian — Soule Steam Feed Works
Vicksburg — O'Neill-McNamara Hardware Co.

MISSOURI

Cape Girardeau — N. O. Nelson Co.
Jefferson City — N. O. Nelson Co.
Joplin — Joplin Supply Co.
Kansas City — Mid-States Supply Co.
Reeves-Wiedeman Company
No. Kansas City — Grinnell Company, Inc.
St. Joseph — Missouri Water & Steam Supply Co.
St. Louis — Donley Pipe & Supply Co.
N. O. Nelson Co.
Springfield — John A. Rhodes Co.

MONTANA

Butte — Montana Hardware Company
M. & L. Supply Co., Inc.
Missoula — Missoula Mercantile Company

NEBRASKA

Lincoln — Western Supply Company
Omaha — John Day Rubber & Supply Co.
Midco Supply Co.

NEVADA

Reno — Acme Supply & Equipment Co., Inc.

NEW HAMPSHIRE

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Manchester Supply Company
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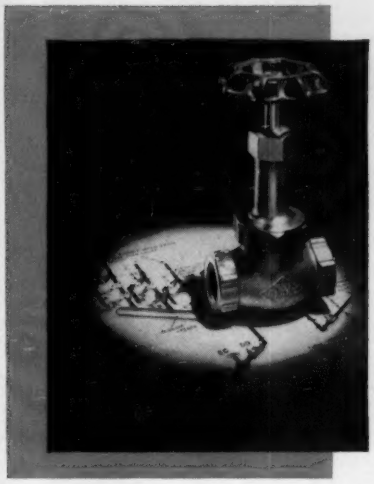

NEW JERSEY

Atlantic City	Seashore Supply Company
Bayonne	Bayonne Plumbing Supply Co.
Bridgeton	Hajoca Corporation
Camden	Fleck Company
	Hajoca Corporation
	J. D. Johnson Co., Inc.
Elizabeth	Elizabeth Hardware Company
Harrison	William S. Roe, Inc.
	Div. of Charles F. Guyon, Inc.
Irvington	Gerweck & Auerbacher, Inc.
Jersey City	The Ideal Supply Co., Inc.
New Brunswick	Behrer-Nason Company, Inc.
	Raritan Supply Company
Newark	Geo. J. Keller Co.
	John Simmons Company
Passaic	Central Eng'ring & Supply Co., Inc.
	A & J Friedman Supply
	Power Pipe & Supply Co., Inc.
Paterson	Federal Supply Co.
	Paterson Supply & Engineering Co.
Perth Amboy	Madsen & Howell, Inc.
Trenton	Manufacturers Selling Company
Vineland	Endicott Supply Company

NEW YORK

Albany	Sager-Spuck Supply Co., Inc.
Binghamton	Binghamton Industrial Supply Co.
	Chas. Millar & Son Co.
	Ellis W. Morse & Co.
	Sage Supply Co., Inc.
Buffalo	W. A. Case & Son Mfg., Co.
	Stritt & Priebe, Inc.
Elmira	Irving D. Booth, Inc.
	LeValley McLeod, Inc.
Ithaca	Haverstick & Co.
Jamestown	Clark Hardware Co.
Kingston	W. A. Case & Son Mfg. Co.
Long Island City	Conran Supply Co., Inc.
	Gar Supply Corp.
	Mayer-Malbin Company, Inc.
Middletown	Orange County Plumbing Supply Co.
Mineola	Behrer-Nason Company, Inc.
Newburgh	W. A. Case & Son Mfg. Co.
	W. L. Smith Co.
New York City	Asco Supply Company, Inc.
	Behrer-Nason Company
	Davis & Warshow, Inc.
	B. F. Gilmour Co., Inc.
	Glauber, Inc.
	Charles F. Guyon, Inc.
	W. H. Hussey & Son, Inc.
	H. R. Kelly Company, Inc.
	McElraevy & Hauck Co.
	N. Y. Plumbers' Specialties Co., Inc.
	Herbert Reck Supply Corporation
	Saltser & Weinsier, Inc.
	Sidney Samuels, Inc.
	Simplex Plumbing Supply Co.
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	John Wilfert Company
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Poughkeepsie	Interstate Plumbing Supply Co., Inc.
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	Haverstick & Co.
	Samuel Sloan & Co.
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	Edward Joy Co.
Utica	Chas. Millar & Son Company
White Plains	Behrer-Nason Company, Inc.
Woodside	Neill Supply Co., Inc.
Yonkers	Glauber, Inc.
	Joseph C. Ryan & Sons, Inc.

NORTH CAROLINA

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Charlotte	Grinnell Company, Inc.
	Hajoca Corporation
	Textile Mill Supply Co.
	The Henry Walke Company
Durham	Dillon Supply Co.
	Noland Company, Inc.
Fayetteville	Piedmont Supply Co., Inc.
	Standard Supply Co., Inc.
Gastonia	Gastonia Mill Supply Co.
Goldsboro	Dillon Supply Co.
Greensboro	Frank Hockett Supply Co.
	Piping & Equipment Supply Corp.
Hickory	Piedmont Supply Co., Inc.
High Point	Kester Machinery Co.
Kinston	Noland Company, Inc.
Raleigh	Dillon Supply Co.
	Noland Company, Inc.
Rocky Mount	Dillon Supply Co.
Salisbury	Piedmont Mill Supply Co., Inc.
Shelby	Shelby Supply Co.
Wilmington	Mill & Contractors Supply Co.
Wilson	Noland Company, Inc.
Winston-Salem	Kester Machinery Co.
	Noland Company, Inc.

OHIO

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Canton	Mahoning Valley Supply Company
Chillicothe	Grinnell Company, Inc.
Cincinnati	The Murdock Mfg. & Supply Co.
Cleveland	American Rad. & Std. Sanitary Corp.
	Strong, Carlisle & Hammond Co.
Columbus	The Smith Bros. Hardware Company
	Westwater Supply Company
Dayton	The Acme Plumbing Supply Co.
	Dills Supply Company
Lancaster	The Raedel Hardware Co.
Lima	American Rad. & Std. Sanitary Corp.
Lorain	American Rad. & Std. Sanitary Corp.
Mansfield	Conte Plumbing & Heating Sup., Inc.
New Haven	New Haven Supply Co.
Sandusky	Brohl & Appell Co.
Steubenville	Industrial Supplies Co.
Toledo	The Hardy & Dischinger Co.
Youngstown	Valley Pipe & Supply Co.
Zanesville	Industrial Supplies Co.

OKLAHOMA

Oklahoma City	Mideke Supply Co.
Tulsa	Ardun Supply Company
	Marshall Supply & Equipment Co.

OREGON

Astoria	Fisher Bros.
Eugene	American Steel & Supply Co.
No. Portland	Moore Dry Kiln Co.
Portland	Harris Supply Company
	J. E. Haseltine & Co.
	Paramount Supply Co.
Salem	Salem Steel & Supply Co.

PENNSYLVANIA

Allentown	Lehigh Valley Supply Co.
Bethlehem	Hajoca Corporation
Chester	Hajoca Corporation
Easton	H. P. Kinsey Company
Erie	Palace Hardware Supply Company
Franklin	Jolley Industrial Supply Co.
Harrisburg	Appleby Bros. & Whittaker Co.
Haverford	Plumbers Supply Co., Inc.
Lancaster	Herr and Company, Inc.
Lansdale	Hajoca Corporation
Norristown	United Pipe & Supply Co., Inc.
Philadelphia	Herman Goldner Co., Inc.
	Grinnell Corporation
	Hajoca Corporation
	Henry B. Pancoast Company
	C. J. Rainear & Co., Inc.
Pittsburgh	Pittsburgh Gage & Supply Co.
Pottsville	Reading Foundry & Supply Co.
Reading	Hajoca Corporation
	Reading Heater & Supply Company
Scranton	Ralph E. Weeks Co.
Sharon	Pittsburgh Gage & Supply Co.
Titusville	Pittsburgh Gage & Supply Co.
Wilkes-Barre	Eastern Pennsylvania Supply Co.
Williamsport	E. Keeler Company
York	Fulton, Mehring & Hauser Co., Inc.

RHODE ISLAND

Providence	Allen & Reed Company
	Grinnell Company, Inc.
	Rhode Island Supply & Eng'ring Co.
Woonsocket	Woonsocket Supply Company

SOUTH CAROLINA

Anderson	Sullivan Hardware Co.
Charleston	B. L. Montague Co., Inc.
	Noland Company, Inc.
Clinton	Industrial Supply Co.
Columbia	Columbia Supply Co.
	Noland Company, Inc.
Greenville	Poe Hardware & Supply Co.
	Stewart Supply Co.
	Sullivan Hardware Co.
Spartanburg	Hall & Company, Inc.
	Noland Company, Inc.
Sumter	B. L. Montague Co., Inc.

TENNESSEE

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Chattanooga	Mills & Lupton Supply Co.
Jackson	Southern Supply Co.
Kingsport	Greene Hardware & Supply Co.
Knoxville	Tennessee Mill & Mine Supply Co.
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	N. O. Nelson Co.
Nashville	Buford Brothers, Inc.
	W. A. Case & Son Mfg. Co.
	Noland Company, Inc.

TEXAS

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Dallas	N. O. Nelson Co.
El Paso	Zork Hardware Company
Fort Worth	Well Machinery & Supply
Houston	Corbett Corp.
	N. O. Nelson Co.
Lufkin	Supply Div. of Lufkin Const. Co.
Marshall	E. B. Hayes Machinery Co.
Paris	Robert L. Swain Co.
San Antonio	San Antonio Pipe & Supply Co.
Texarkana	Buhrman-Pharr Hardware Co.

UTAH

Salt Lake City	N. O. Nelson Co.

VERMONT

Burlington	The Blodgett Supply Co., Inc.
Rutland	Canney-Plue, Inc.
St. Johnsbury	Charles Millar & Son Co.

VIRGINIA

Charlottesville	Noland Company, Inc.
Danville	Hajoca Corporation
Lynchburg	Barker-Jennings Corp.
Newport News	Noland Company, Inc.
Norfolk	Hajoca Corporation
	The Henry Walke Company
Richmond	Hajoca Corporation
	Industrial Supply Corporation
	Noland Company, Inc.
	Southern Railway Supply Co.
Roanoke	Graves Humphreys Hardware Co., Inc.
	Noland Company, Inc.
Waynesboro	Mize Supply Company

WASHINGTON

Seattle	Northern Commercial Co.
	Steam Supply & Rubber Co.
Spokane	Northwest States Supply Co.
	Sullivan Valve & Engineering Co.
Tacoma	Paramount Supply Co.
Walla Walla	Drumheller Co.

WEST VIRGINIA

Charleston	McJunkin Corporation
Clarksburg	Osborn Machinery Co., Inc.
Huntington	Logan Hardware & Supply Company
Logan	Logan Hardware & Supply Company
Weston	Danser Hardware & Supply Co.
Wheeling	Trimble & Lutz Supply Co.

WISCONSIN

Appleton	W. S. Patterson Co.
Green Bay	Murphy Supply Co.
Kenosha	P. H. & I. Supply Co.
LaCrosse	W. A. Roosevelt Co.
Madison	Automatic Temperature Supplies, Inc.
	Rundle Spence Mfg. Co.
Manitowoc	William Rathsack & Sons Co.
Milwaukee	F. R. Dengel Co.
	B. Hoffmann Mfg. Co.,
	Div. Grinnell Company, Inc.
	Rundle Spence Mfg. Co.
Nekoosa	Nekoosa Fdry. & Mchne. Works, Inc.
Oshkosh	Battis Bros.
Racine	Thomas Supply Co.
Sheboygan	Optenberg Iron Works
Watertown	Kusel Dairy Equipment Co.

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Start with these quick samples . . .

Twice the size . . .

of any existing boiler-feed pump in this country, Byron Jackson's 12,000-hp unit is being built to deliver 6330 gpm at total dynamic head of 6400 ft. More facts on this development, plus the dope on Penn State's new research reactor, and other news in . . .

Reports From the Field, p 152

High-frequency power . . .

is not new in industry but its use has been limited. Now the demand for smaller, lighter motors for specialized operations gives h-f power a big boost. Latest technical report on the subject is digested for your quick review. Many other abstracts on electric power, reactor designs, waste disposal.

Technical Briefs, p 154

No cause to worry . . .

when equipment is protected by new monitoring technique that continuously checks itself. Procédure: simulated unsafe condition is periodically introduced resulting in a safe-unsafe oscillation. When failure of safe condition is sensed, a warning sounds. Full details, plus low-down on other problem-solving products.

Plant Equipment News, p 158

Pipeline-expansion problems . . .

get full treatment in an informative 24-p bulletin offered by the Flexonics Corp. Use handy post cards provided to get your copy of it or any of the other 30-odd items in this month's listing.

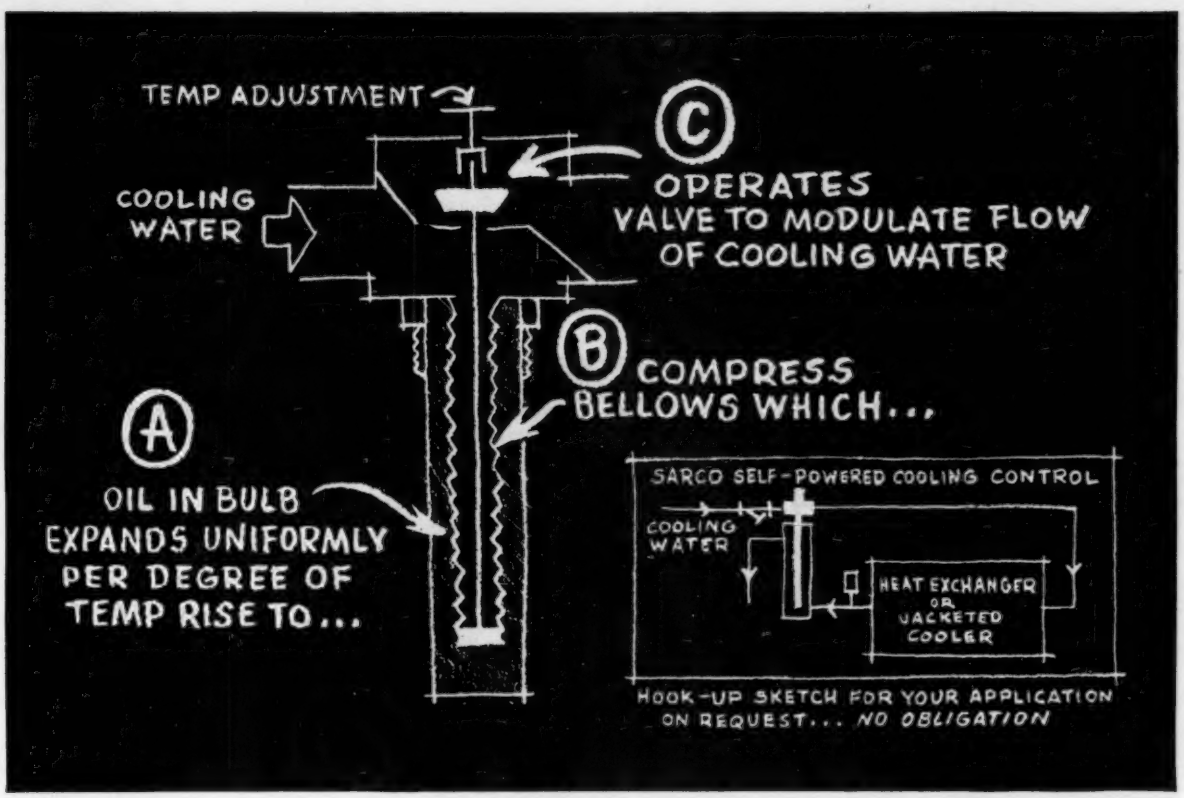
Free Literature, p 167

A friendly reminder . . .

that we can't turn the clock back comes in the form of an interesting experience told by our good engineer-friend . . .

George Edwards, p 170

For other timely ideas, see following service pages ▶


TEMP ADJUSTMENT
COOLING WATER
C
OPERATES VALVE TO MODULATE FLOW OF COOLING WATER
B
COMPRESS BELLOWS WHICH...
A
OIL IN BULB EXPANDS UNIFORMLY PER DEGREE OF TEMP RISE TO...
SARCO SELF-POWERED COOLING CONTROL
COOLING WATER
HEAT EXCHANGER OR JACKETED COOLER
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Simple, inexpensive way to end waste and hazards of overcooling

WHEN cooling water is manually controlled ...the operator is forced to play it safe by leaving the water valve wide open to compensate for variables in the load and water pressure and temperature. Result—*overcooling*. If he tries to vary the flow of water...he risks *undercooling*.

It pays to take responsibility off the operator's shoulders. Optimum *safe* temperature can be automatically assured by using Sarco Cooling Controls. They eliminate both overcooling and undercooling. They replace guesswork with certainty. Save man-hours and cooling water. Prevent damage to equipment.

Simple and Trouble-Free

Simple, trouble-free design—as you can see above, a temperature control need not be complicated! Self-powered...no electricity or compressed air required. Self-contained...no exposed mechanism. Packless...no packing to wear or leak.

Each year, thousands of these fully modulating and sensitive Sarco Controls provide dependable service for firms such as Ingersoll-Rand, Butler Manufacturing Co., and Swift & Co.

Low Price

The low price makes it possible for you to use Sarco AUTOMATIC temperature controls for ALL control jobs, not just the big ones! For example, the ¾" size costs only about $39! Mail the coupon now.

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Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.
Please send information on your simple, inexpensive Self-Powered Cooling Controls for use on_____

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Address_____
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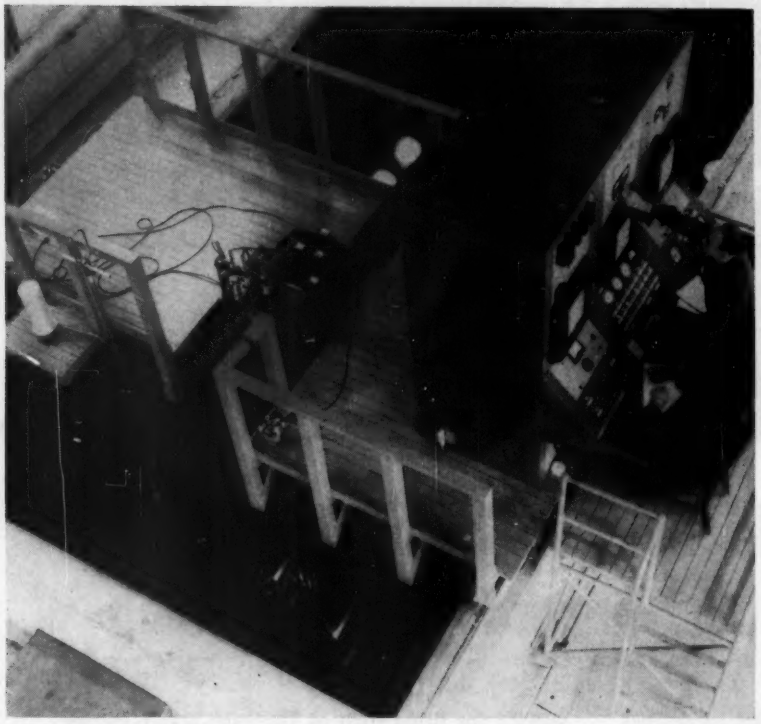
REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 242



LOOKING DOWN on the bridge over Penn State's new research reactor. Cubicle containing recorders and auxiliary controls is at right; electric drive unit for control rods is in center, directly over "swimming pool."

Reactor has latest in operating, safety controls

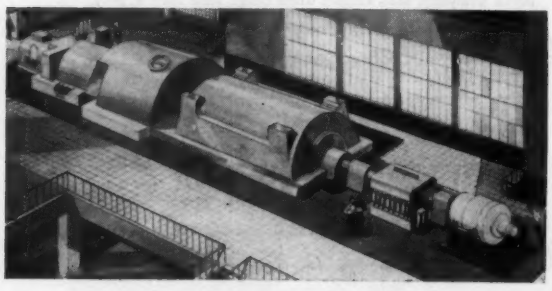
► PENN STATE'S new research reactor —now operating near its full 100-kw power level—features the latest in centralized instrumentation for nuclear processes. Engineered by Leeds & Northrup, measuring and controlling systems guide operation safely through the critical raising of power levels and automatically hold power within ± 1% of desired operating level. Interlocked "scram" controls safeguard the unit and operating personnel.

The $300,000 reactor is primarily a source of neutron beams which are useful in diffraction or similar studies and to produce radioactive isotopes of short half-life. These are important in biological, physical and metallurgical research. Special projects for Pennsylvania industry are also planned. In addition, the reactor will simplify instruction in nuclear science.

Similar to the Oak Ridge BSF Reactor, the Penn State unit has a core with its familiar gridwork of U-235 fuel elements placed at the bottom of a 20-ft deep "swimming pool." A research laboratory at one end of the pool receives neutron beams, collimated by holes through a special biological shield of 44-in. thick high-density concrete.

Separate systems, called "channels," guide reactor operation for (a) initial start-up (b) intermediate power build-up and (c) automatic control at the operating power level. Additional channels provide for slow, intermediate and fast scram—depending upon the criticalness of failures that call for shut-down. Safety channels are designed in accordance with AEC Reactor Safeguards Committee qualifications.

At start-up, a log count rate channel is used to monitor reactor operation. Individual neutron count in a fission measuring chamber is measured electronically and the logarithm of its value plotted on a strip-chart recorder. Chart record is used as a guide for manually raising reactor control rods at the proper rate. If rate of power increase exceeds prescribed limit, safety circuits take over.



Start work on world's largest feed pump

► WORLD'S LARGEST boiler feed pump—rated at 12,000 hp —will deliver 6330 gpm at a total dynamic head of 6400 ft, or about 2700 psi at a speed of 3510 rpm. The unit is being built by Byron Jackson for Consolidated Edison Co of New York. According to BJ engineers it will be at least twice as large as any boiler feed pump now in existence in this country. It will consist of a cylindrical outer barrel and cover enclosing a horizontally-split inner volute case.

(*For More Reports From the Field, turn to page* 242)

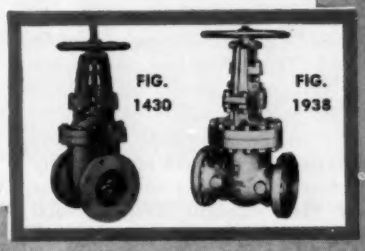
LUNKENHEIMER OPENS

New Modern IRON and STEEL VALVE PLANT

THIS 400-foot machine bay—one wing of the new Lunkenheimer plant—houses the industry's most up-to-date precision equipment for manufacturing iron and steel valves.

Here, old-world craftsmanship and attention to detail—a Lunkenheimer tradition since 1862—are combined with modern production facilities to assure the highest standards of quality. Lunkenheimer Iron and Steel Valves are world-famous for long life and low maintenance. Their shoulderless seat rings will not warp, and the gates have exclusive machined disc guides that eliminate "chatter" and reduce wear.

This entirely new iron and steel valve plant is located next to the Lunkenheimer bronze plant, which was completely modernized a few years ago in a sweeping $3 million program. Together, they give you the finest, most dependable valves that man can build or money can buy. The Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.



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ELECTRIC POWER
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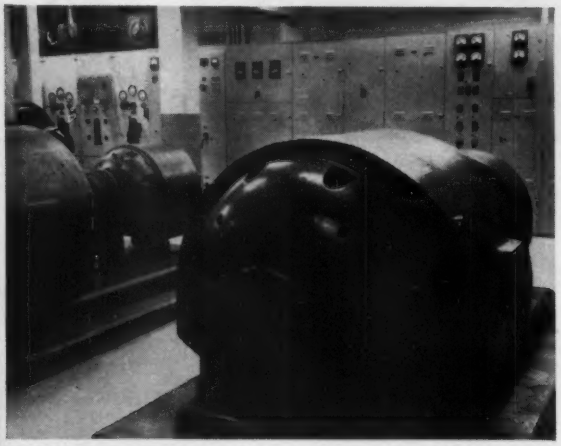
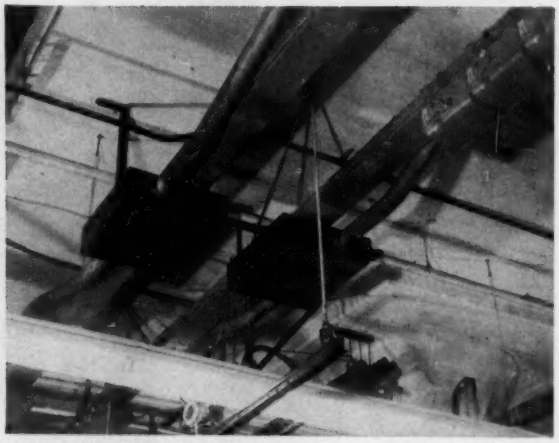


GENERATORS, rated at 150 kw at 420 cps, installed in factory



OVERHEAD BUSWAY: 420-cps power gives flexibility, economy

High-frequency power — key to smaller and lighter a-c motors

Utilization of 300 to 2000 cycle power in industry. *By Vernon C Geckler, New Departure Division, General Motors Corp.*

Use of electric power with frequencies higher than 60 cps is not new to industry—the author's firm developed the first application of 300-cps power in 1904 and is considered the pioneer in this field. Today, high-frequency power is a recognized source for internal grinding, portable tools, production assembly lines, woodworking tools, etc.

High-frequency motors are generally about four times smaller and four times lighter than standard 60-cps motors. Three-phase motors are usually used for high frequencies because they are the simplest and most troublefree type.

Power sources used include motor-generator sets and converters. Motor-generator sets are the most common units used and are obtainable on special order from larger equipment manufacturers. Converters are desirable for fixed-load applications like furnaces.

Generator voltage may be used directly or transformed in the same manner as 60-cps power. Special high-frequency transformers must be used. They add a substantial amount of reactance to the system.

High-frequency power can be distributed by a parallel 3-conductor line connected at both ends, a 3-conductor cable within one enclosure or use of concentric cables with one conductor in the center and another on the outside. Three properly phased conductors of this type are effective in reducing the reactance.

In the future it appears that smaller generating units will be used for high-frequency power generation. They will be located and sized for a particular production line. Development of an electronic unit may not be too far off. It will have the ability to vary the frequency within the range required by the machine to which it is attached. *APC paper; no number.*

Operation and maintenance of hydrogen systems for turbine generators. *By S C Barton and W H M Olson, General Electric Company.*

Starting with a description of the various types of hydrogen systems built by their company, the authors of this paper move on to the importance of efficient and reliable systems in terms of possible losses. With these facts clearly set forth, the paper next discusses installation, operation and maintenance of these systems.

Paragraphs devoted to installation, operation and maintenance are excellent and should be of much value to every operator concerned with the types of hydrogen systems discussed. *AIEE paper No. 56-293.*

Research for the electric utility industry and other electric power industry in Japan. *By K Masui, Central Research Institute of Electric Power Industry, Japan.*

The electric utility industry in Japan consists of nine power companies supplying electricity to all parts of the country. Great demand for electric service has created many problems that can be solved only by research. This condition has been recognized and active engineering and economic research projects have been instituted.

The paper briefly describes development of the industry in Japan, problems met, importance of speeding up research and policies and means used in directing and conducting research. *AIEE paper No. CP 56-282.*

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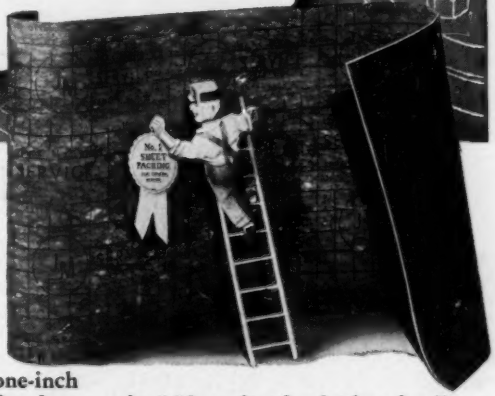
Sure J-M Service Sheet is equally good for oil, steam and gas lines!



Your J-M Packings Distributor can tell you why this quality sheet packing has maintained such an excellent reputation for over 35 years

Where it's used: Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

What its advantages are: J-M Service Sheet is a quality packing, made of selected long-fibre asbestos bonded with heat-resisting compounds. It is graphited on one side to permit breaking a joint without destroying the gasket. The ungraphited side is ruled into one-inch squares to speed cutting and reduce waste. And . . . you can order it in large economical quantities because J-M Service Sheet will not dry out in stock!

How it is furnished: Service Sheet is supplied in sheets 54″ x 63″, 36″ x 126″, 36″ x 63″, and 54″ x 126″ sheets in thicknesses of 1/64″ to ¼″ and 108″ x 126″ sheets in thicknesses of 1/32″ to ¼″. It is also furnished as cut gaskets in standard and special shapes. See the J-M catalog for further details.

Your J-M Packings Distributor carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

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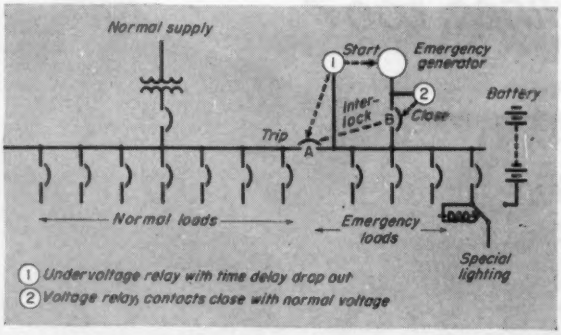
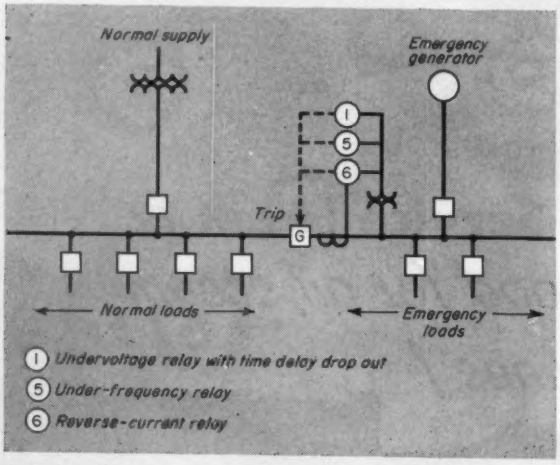
More TECHNICAL BRIEFS

Begins on page 154



SWITCHING hookup for generator which is idle until emergency



HOOKUP for paralleling emergency generator with the system

Power services for various types of buildings and plants

Emergency services for commercial buildings. *By E P Peabody, General Electric Company.*

This paper discusses a number of factors in providing emergency power services for a variety of buildings. Items discussed include lighting, power, power sources, batteries, local generation, dual-service connection, transfer schemes, special precautions, etc. Two of the transfer schemes considered in the paper are shown above. *AIEE paper No. 56-390.*

Throwover equipment and unit equipment for emergency lighting. *By Carl Ippolito, Dual-Lite Company.*

This is an interesting and useful paper discussing standardization of emergency lighting, underwriters' laboratories approvals, panic and auxiliary systems, nickel-cadmium batteries, automatic battery charging, zoning for inside area protection, panic-system supervision, exit-sign and doorway-area illumination and emergency lighting circuits. *AIEE paper No. CP 56-279.*

Directions for ordering papers on p 240

Emergency power for hospitals. *By N L Griffin, U.S. Public Health Service.*

The concept of emergency service for hospitals has changed considerably in the past few years. It has progressed with the working and living habits to which people have become accustomed. Various ideas on the extent and method of applying emergency power have been incorporated into hospital designs. A carefully worked out code for hospital emergency power is desirable.

Items discussed in the paper include evolution of emergency power, sources of emergency power, facilities to be served, emergency power systems, wiring arrangement and maintenance of the emergency system. *AIEE paper No. CP 56-278.*

Selection of utilization voltages for large commercial buildings with primary service. *By D L Johnson and Donald Beeman, General Electric Co.*

Proper selection of utilization voltages determines the most economical power system for large commercial buildings that are supplied primary power. Two primary power voltages are considered in this paper—4160 and 13,800 v. These are representative of the 5- and 15-kv classes, respectively.

Two basic economic comparisons are given: (1) selection of voltage for supplying the air-conditioning compressor drive. (2) selection of 480Y/277 or 120/208Y v for supplying general area lighting and miscellaneous floor loads. Both selections are for a 20-story office building. *AIEE paper No. CP 56-277.*

Fault protection in large buildings supplied by 265/460-volt network. *By W Deans, I-T-E Circuit Breaker Co, J De Lellis and A J Bisson, Consolidated Edison Company of New York.*

Many new commercial buildings are considering distribution voltages in the 265/460-v range. Reason for this is the large loads resulting from central air conditioning, high levels of illumination and increased use of business machines. Installation of multi-transformer network service is justified.

Results of this paper show that complete fault protection is obtainable in the building by proper application of commercially available equipment. *AIEE paper No. CP 56-250.*

The operation of the self-balancing magnetic amplifier. *By A D Krall and E T Hooper, U.S. Naval Ordnance Laboratory. AIEE paper No. 56-204.*

Power supply development for the Atomic Energy Commission's Paducah area diffusion plant. *By E E George, Ebasco Services, Inc, K E Hapgood, TVA and F W McCloska, Sargent and Lundy. AIEE paper No. 56-216.*

Corrosion as it affects insulator and conductor hardware. *By A W Bardeen and J M Sheadel, Ohio Brass Co. AIEE paper No. 56-230.*

(*Continued on page* 231)

New FW Homogeneous Reactor

for LOW-COST ATOMIC POWER

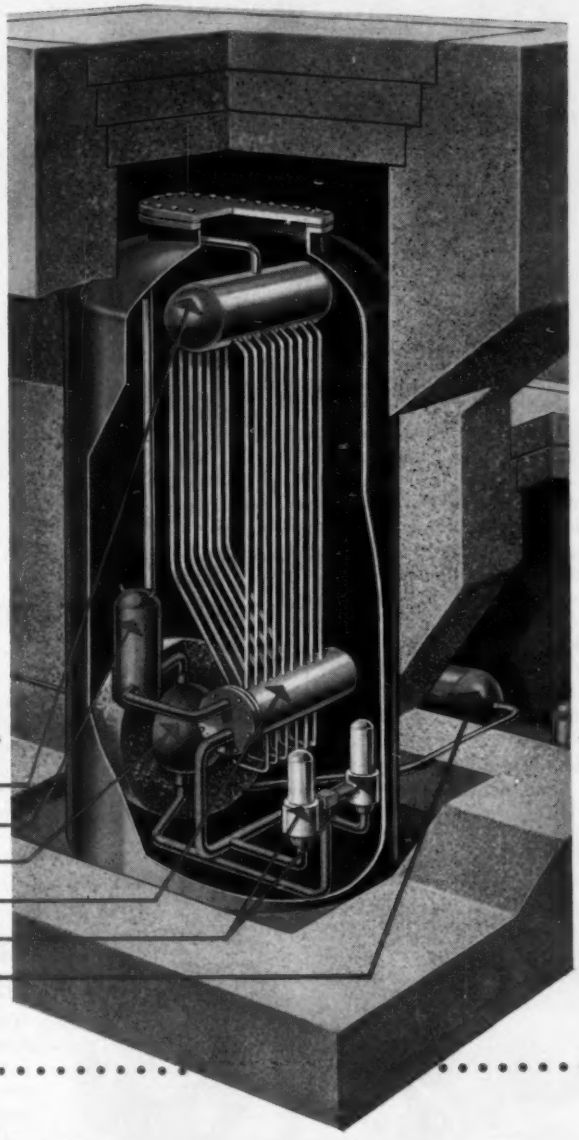
in the 5,000 to 40,000 kw output range

Simplicity of design, exceptional stability and ease of control are outstanding features of this small homogeneous power plant

The one-region aqueous homogeneous reactor illustrated in the cut-away drawing at the right has been designed by Foster Wheeler for economical production of electric power in the 5,000 to 40,000 kw range. It offers these unique advantages.

1. Reactor design is based on optimum nuclear parameters rather than heat removal.
2. Continuous chemical purification of the liquid reactor fuel removes fission and corrosion products.
3. No control or safety rods are necessary. Large negative temperature coefficient of reactivity enables reactor power to follow load demands rapidly and faithfully.
4. Reactor vessel is a simple, spherical pressure vessel.

Liquid fuel is pumped from the reactor to a heat exchanger and the steam thus generated can be superheated and used to drive a conventional turbo-generator. For more complete information, send for a copy of the November issue of Heat Engineering. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



(HOT portions of circuit shown in red)

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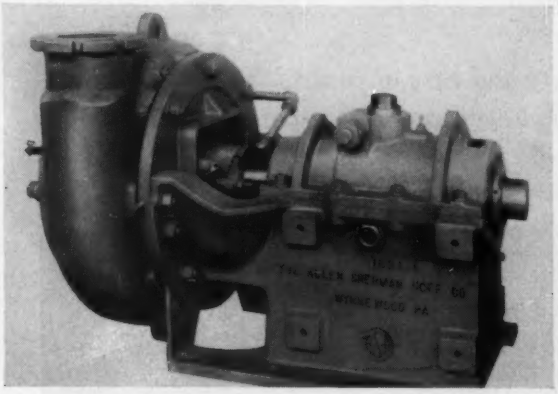
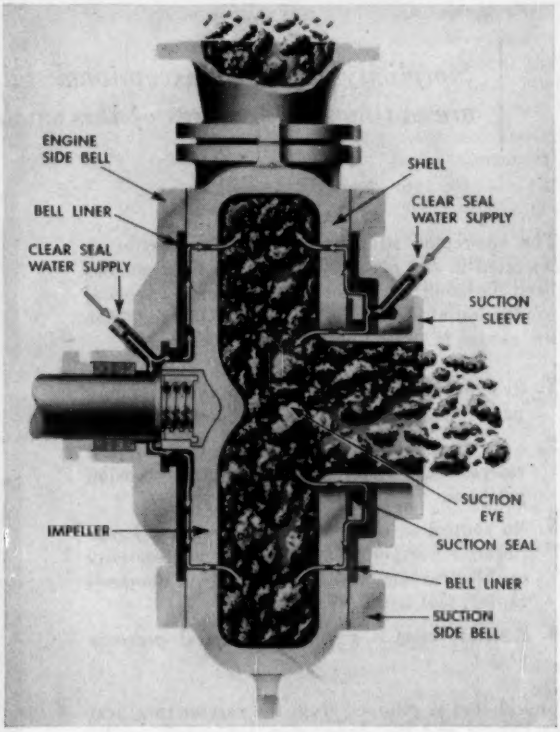


Centrifugal-type pumps transport abrasives at high efficiency



501 • Improved line of centrifugal-type pumps are designed for transporting mixtures of abrasive materials such as ash, slag and flyash from power plants and coke from petroleum plants.

Known as the *Hydroseal* line these pumps are available in two types. One employs rubber, neoprene or other synthetic lining and is suitable for pumping fine solid materials —especially where resistance to chemical action is important. A second type employs hard metal alloy wearing parts and is suitable for handling sharp edged solids that would tend to cut the softer non-metallic linings.

These pumps employ the *Hydroseal* principle, diagram above right. A small stream of clear water (arrows) flows continuously through the clearance spaces between the rotating impeller and stationary parts into the shell (volute) and suction eye of the impeller.

This stream protects the shaft, stuffing box and suction seal from abrasive-laden water and thus eliminates possibilities of frictional wear and enlargement of running clearances between moving parts. It also forestalls recirculation of fluid-solid mixture back to suction eye of the impeller —eliminating inefficiencies of "double pumping."

Since there is no need to compensate for wear, any fixed pumping condition can be maintained without changing motor or pump speed. However, a change of V-belt drive ratio will adapt the same pump to a wide range of capacities and heads. Further details on request to manufacturer.

The Allen-Sherman-Hoff Company,
259 E Lancaster Avenue, Wynnewood, Pennsylvania

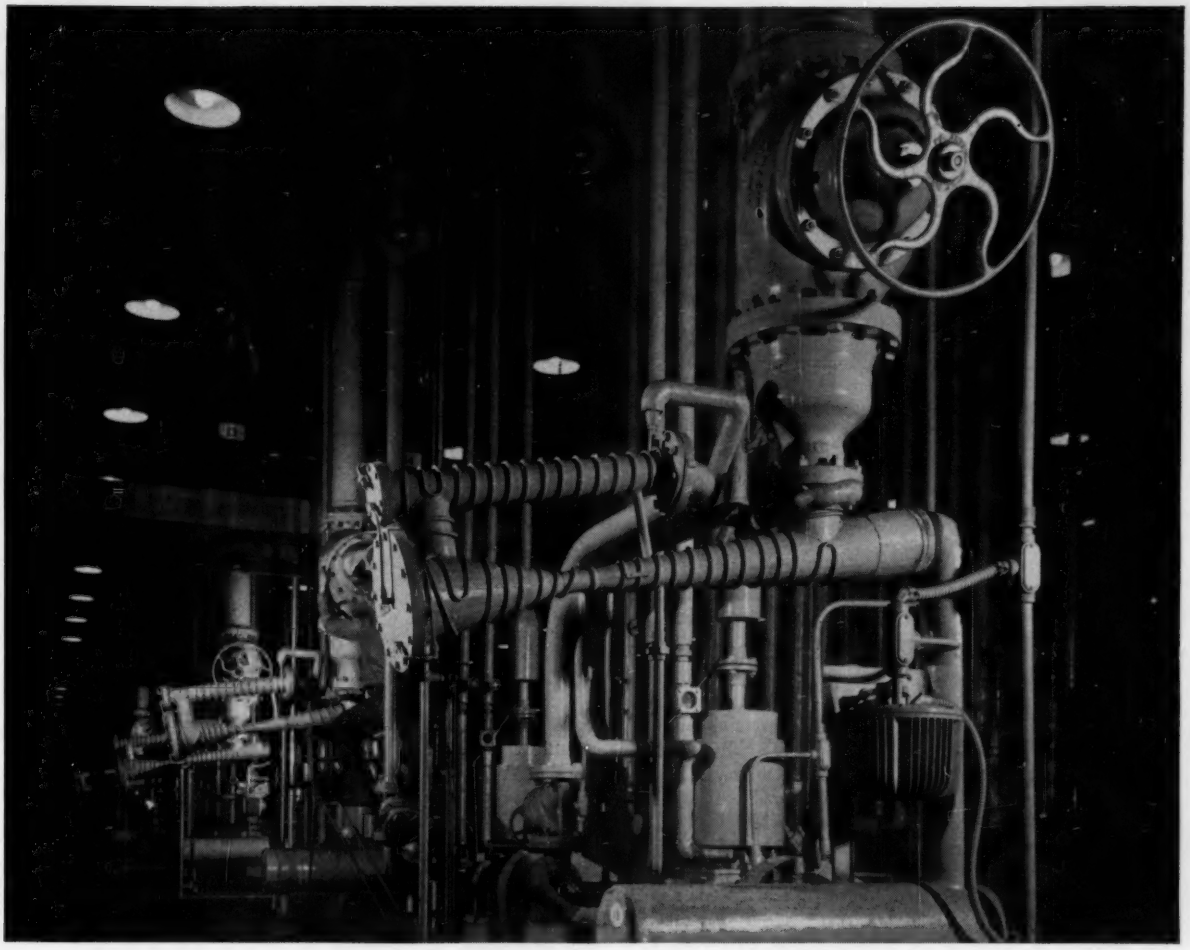
For more data on these items, use post cards page 167. Identify your request with item number.

Pumps for general and chemical service

502 • Only three parts—impeller, casing and back head cradle—vary with size and capacity of this line of seven standard centrifugal pumps. Sizes range from 1 x 2 in. to 3 x 4 in. Pumping capacity extends to 600 gpm and total dynamic head to 275 ft. Pumping temperatures cover a range from minus 40 F to plus 350 F.

Designed for both general and chemical service, construction permits removal of impeller and cradle without disturbing suction or discharge piping. Further details in bulletin 190, available on request to the manufacturer.

Dean Brothers Pumps Inc, Indianapolis, Indiana



These Crane valves holding 25 microns absolute pressure after 2 years on vacuum service

The Case History—Valves frequently are the most critical points in a vacuum system. But that's not the case with this large Southern light metals refiner.

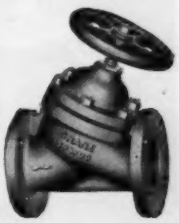
This plant reports no trouble or expense over a 2-year period in maintaining a vacuum of less than 25 microns absolute for its distillation process.

The tight-holding valves installed about 2 years ago on the lines from vacuum pumps shown above are Crane No. 1611 diaphragm pattern. These 12-in. packless iron body valves are used about once daily.

They've allowed no in-leakage at the seat, bonnet-joint, or through the diaphragm. No maintenance whatever has been given the valves since installed. They operate easily and look good for such service indefinitely.

This high efficiency performance is mainly due to Crane separate disc and diaphragm design. The diaphragm used as a bonnet seal only is not subject to destructive crushing. Conventional type disc and body seat provide a metal-to-Neoprene seating that's ideal for vacuum and hard-to-hold fluids.

Moderately priced, Crane diaphragm valves deserve your consideration for many ordinary services, as well as sludges, slurries and corrosive fluids. They are made in a wide variety of body and trim materials, in ½ to 12 in. sizes.



Ask your local Crane Representative about them, or write to address below for literature.

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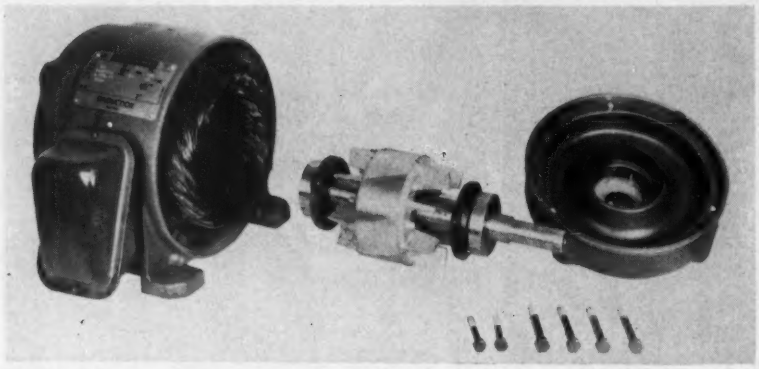
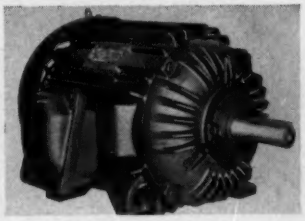
More EQUIPMENT NEWS

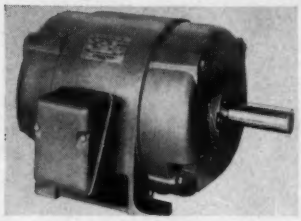
Begins on page 158



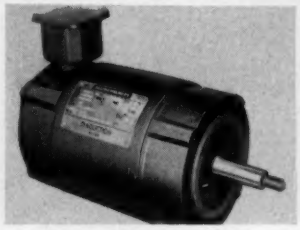
VIEW of typical *Synduction* motor disassembled. Unit uses a simple die-cast rotor



Enclosed fan-cooled unit



Open-type dripproof unit



Flange-mounted motor

New synchronous motors rated from ¼ to 40 hp

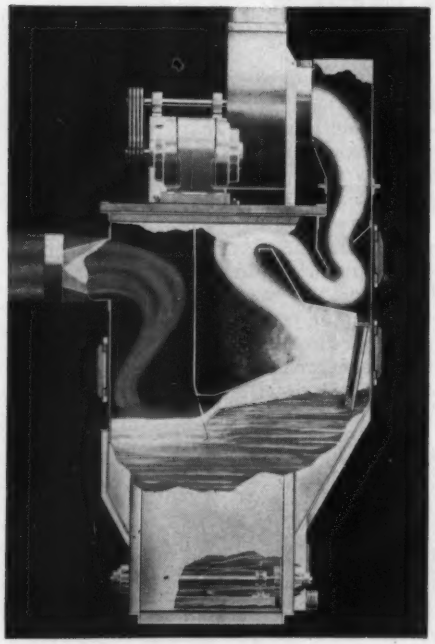
503 • *Synduction* motor for general industrial use is available in ratings from ¼ to 40 hp. It is built on standard induction motor frames and enclosures and uses a simple die-cast rotor. The motor requires no brushes, slip rings or windings on the rotor, separate source of direct-current excitation or special starting equipment, according to manufacturer.

The unit is said to approach the efficiency and power factor of squirrel-cage motors. It starts as an induction motor with a very high locked-rotor torque, accelerates and pulls into synchronism quickly and runs as a synchronous motor. Having a high (175 to 200%) pull-out torque, the motor remains in synchronism regardless of load or line voltage fluctuations.

The motor has been designed to operate over a wide frequency—and wide speed range. Frequencies of 300 cycles and speeds above 10,000 rpm are available. Motors for frequencies as low as 10 cycles have been developed.

Allis-Chalmers Manufacturing Co, Milwaukee 1, Wisconsin

For more data on these items, use post cards page 167. Identify your request with item number.



Wet dust collectors in capacities from 1000 to 30,000 cfm

504 • *Ventrijet* wet dust collector achieves proper atomizing of water and mixing with the air stream to permit efficient dust transfer by the movement of air without mechanical means, according to the manufacturer.

Dust-laden air enters the collector and expands in the inlet chamber at reduced velocity. Heavier particles sink to the bottom of the tank as sludge. Air is drawn through one or more venturi tubes into the discharge chamber. The low-pressure area in venturi throat induces water also to enter the high-velocity air stream. Mixing of air and water causes transfer of dust particles from the air to the water particles.

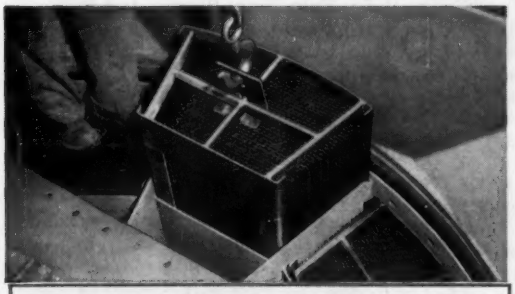
Air, water and sludge mixture impinges at high velocity on special surfaces in the discharge chamber. Sludge settles to the tank bottom. Washed air then flows through an eliminator section for removal of droplets and clean air is discharged.

The *Ventrijet* is available in a range of capacities from approximately 1000 to 30,000 cfm in single and double row tube types. Further details on request to the manufacturer.

Pangborn Corporation, Hagerstown, Maryland

For news of recent valve developments, turn page ►

air preheater installations are Ljungstrom®



Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Reduces fuel consumption. Permits use of lower-grade fuels. Increases boiler output and reliability.
- Eliminates cold spots...keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

MINIMUM CORROSION is an important reason. There are no cold spots in a Ljungstrom. Temperature is uniform on all heating surfaces—corrosion-causing condensation is reduced.

For all the facts, send now for a free copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

More EQUIPMENT NEWS

Begins on page 158

Control valves handle fluids at unlimited pressure

508 • Two new control valves are designed to handle all fluids at unlimited pressures. The diaphragm-actuated *Type CV-D* valve may be direct or reverse in action; has a wider range of application than older-styled units.

Piston-actuated *Type CV-P* valve, photo left, develops high force to deal with static and dynamic unbalances and with stuffing box friction.

Both valves will handle water, steam, air, gas, oil or similar fluids at unlimited pressures. Valve bodies are made of cast iron or cast steel in either straightway or angle style. Designed for individual installations, the fittings are stainless steel, single or double seat, with hardfacing when required. For complete information request bulletin 1027 from the manufacturer.

Copes-Vulcan Division, Blaw-Knox Co, Erie, Pa.

Improved pressure reducing and regulating valve

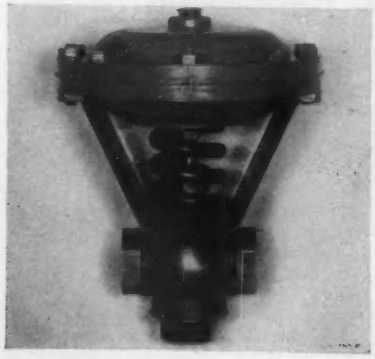
509 • Improved version of this pressure and regulating valve for liquid, steam and gas service include: (1) 50% reduction in the number of flange bolts to save maintenance time (2) gasket seal at diaphragm flange for easier pressure range conversion.

Features retained from the former model include: (1) interchangeable internal working unit (2) easily accessible interior (3) built-in strainer.

Unit is available in iron, bronze, steel or stainless steel body and bronze, stainless steel, nitralloy or monel trim. Screwed ends are ¼ to 2 in.

A W Cash Co, P.O. Box 551, Decatur, Ill.

Small flow valve is designed for on-off service



510 • *Series 700* valve is offered for on-off service on gas, oil, water or steam—air to close, air to open. It is available in sizes ¼ to 1 in.

Body materials are cast bronze, cast iron, cast steel or stainless steel. Unit is recommended for use in chemical, petroleum and equipment manufacturing industries where cost is a determining factor in process design.

Working pressures are 150 to 300 lb as standard—higher pressures on application. Full details on request.

Uniflow Valve Corporation, 19 Quine St, Cranford, N. J.

Flanged check valve

511 • Unit is recommended by manufacturer for control of water hammer for all types of hot or cold liquid service — including water, oils, gasoline, acids, chemicals, salt water, brine—where flow is constant. It is available in sizes from 1 to 10 in., faced and drilled in accordance with ASA standard for pressures ranging from 125 to 2500 lb. The valve can be furnished with special flange facings, including large male and female, ring joint and large tongue and groove.

The Williams Gauge Co, Inc, 2 Gateway Center, Pittsburgh, Pa.

Injection-molded pvc valve

512 • "Self-lubricated" plug valve —injection-molded of polyvinyl chloride—is designed to handle a wide variety of corrosive fluids. Manufacturer states that these valves will reduce replacement costs and down-time, minimize purging and eliminate product contamination problems often experienced when certain fluids encounter metallic components of piping systems. Teflon bearing buttons on the plug provide the self-lubricating characteristic. Straight through port makes possible unimpeded flow conditions.

Unit is furnished with threaded ends or with socket-type ends for solvent welding. Available in 1, 1½ and 2-in. sizes. Details on request.

Tube Turns Plastics, Inc, 2929 Magazine St, Louisville 11, Ky.

4-way solenoid valve

513 • This unit, for control of air, water and light oil to 150 psi, is designed to conform to JIC specifications. Solenoid is inoperative when its cover is removed—there is a manual override that is safe against accidental actuation. Conduit connector is threaded and pressure ring terminals are on 6-in. free leads. Solenoid and junction box are protected by captive cover plates that seal them against airborne contamination. Full details in catalog 6-C, available from manufacturer.

Barksdale Valves, 5125 Alcoa Ave, Los Angeles 58, Calif.

For details on these items use post cards p 167. Identify request with item number.

One of many advantages of 90/10 Cupro-Nickel

WELDABILITY

Welding head on filter shell

One of the relatively new copper base alloys is 90/10 Cupro-Nickel, which is coming into increased use as a result of experience with it. Revere offers it in sheet and plate, pipe and tube. It is highly resistant to corrosion and erosion, particularly in salt or brackish water. In addition it can be cold or hot worked, welded, soldered and polished. Because its nickel content is less than the older 70/30 alloy, it is priced lower.

The item shown here is a 90/10 Cupro-Nickel filter for aviation gasoline, designed and fabricated by the Warner Lewis Company, Division of Fram Corporation, Tulsa, Oklahoma, for the U. S. Navy. Heads and shell are 1⅛" thick. Revere was given the opportunity to collaborate with the Warner Lewis manufacturers on welding, which was successfully accomplished by the metallic arc process, using Inco 70/30 Cupro-Nickel electrodes. The vertical weld on the shell was X-rayed 100% and found satisfactory to pass Navy inspection. Because of the thickness of the metal, it was decided to form the heads hot at around 1690° F. The forming was done by the Hackney Iron & Steel Co., Enid, Okla., which also consulted with Revere.

Warner Lewis Company of Tulsa, with representatives in 30 cities, are specializing on all types of alloy design and fabrication and inquiries of this nature are invited.

If you wish information regarding the selection, welding, or working of copper and its alloys and aluminum alloys, see the nearest Revere Sales Office.

Completed aviation gasoline filter, made of 90/10 Cupro-Nickel

REVERE

COPPER AND BRASS INCORPORATED

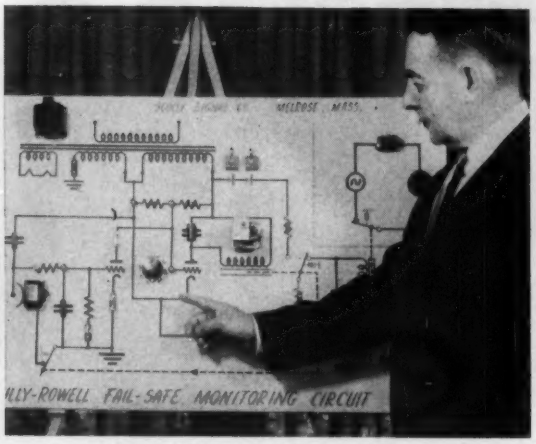
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N.Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

More EQUIPMENT NEWS

Begins on page 158

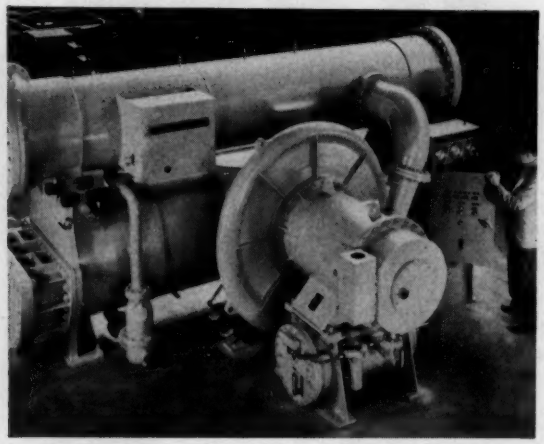


Self-checking monitoring method

514 • This monitoring technique may be used with electronic, electrical, mechanical, pneumatic, hydraulic and nuclear systems, according to manufacturer.

Equipment protective devices and system monitors incorporating this method continually check themselves by periodically simulating the dangerous condition they are designed to detect. The simulated unsafe condition is introduced into the monitor, resulting in a continual safe-unsafe-safe-unsafe . . . oscillation that holds the alarm off. Failure of the safe condition being sensed or of the monitoring system itself halts the required safe-unsafe oscillation and sounds the alarm or initiates corrective action. The period of oscillation can be adjusted. Request full details from manufacturer.

Scully Signal Company, Melrose, Mass.



Centrifugal refrigerating machine

515 • Unit features completely automatic chilled-water temperature control throughout its full range of cooling capacity. Single-stage design contributes to operating efficiency through elimination of two or more compression stages combined with improved diffusion in the volute casing. This compact construction avoids extra impellers, housings and connections and saves space and weight. Machines are presently available for a tonnage range of 240 to 410 tons. Motor ratings are 250 and 300 hp—both suitable for 115% of rated continuous duty. Hermetic motors are available for 208, 220, 240, 440, 460, 480 and 550 volts; 3 phase, 60 cycles, 3-wire and 2-phase, 60 cycles, 4-wire current. Reduced voltage starting equipment is required. Request full details from manufacturer.

American Blower Corporation, Detroit 32, Mich.

For more data on these items, use post cards page 167. Identify your request with item number.

Supply and return ceiling air diffuser

516 • *Type KPSR* square diffuser is geometrically proportional throughout all sizes. It is used where air is to be both discharged and returned through a single unit. At constant neck velocities static pressure for any unit will not vary—assuring uniform diffusion patterns over a large area.

Air is discharged between outer and middle cones and return air is drawn through the center section which has a neck area equal to 75% of the supply. Design prevents "short circuiting" of supply air into return opening, according to manufacturer.

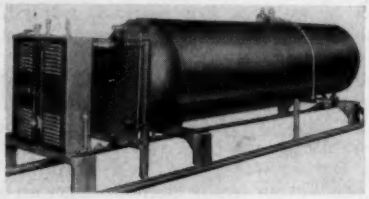
Connor Engineering Corporation, Danbury, Conn.

Lightweight cotton-nylon conveyor belting

517 • This conveyor belting has a load-carrying carcass made of plies of frictioned cotton-nylon fabric—the fabric being woven from high-tension cotton warps and nylon fillers. It is designed for use where (1) regular belting of required plies and weight of duck is too heavy (2) where greater troughing would be advantageous when an installation doesn't have sufficient take-up room (3) where small pulleys are encountered.

Republic Rubber Div, Lee Rubber & Tire Corp, Youngstown, Ohio

Be sure to check this item . . .



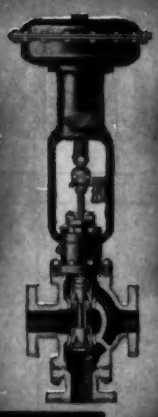
Propane standby plant . . . . p 172

. . . and these and the many others appearing on pages noted below:

Air meter and probe . . . . . p 176
Gas-cooled compressor . . . . . p 178
Ball-type flow indicator . . . . . p 180
Marine-type steam generator . . . . p 182
Industrial oil burners . . . . . p 184

TYPE 657A

uble port globe body for conven-
nal service. Also supplied single
rt where light pressure required.
rmally supplied in iron or steel in
es ½" thru 12".



TYPE 657YY

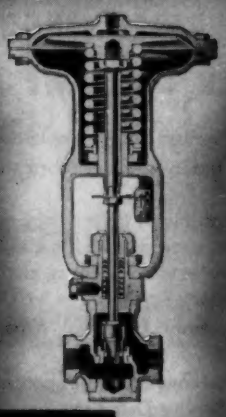
Three-way control valve for by-pass or blending service. Eliminates need for two globe type control valves. Available all castable alloys sizes ½" thru 12".

FISHER®

Has the control valve for your station

TYPE 667Z

dit type body in which parts are
adily accessible; can be econom-
ally supplied in various alloys
r corrosive service. Available in
anged sizes ½" thru 2".



TYPE 510G

Small and compact bronze control valve for relatively light service. Available in screwed sizes ½" thru 2".

TYPE 657-458

gle control valve for handling
ids containing solids, or flashing
uids which are erosive. Normally
pplied in steel flanged ends in
es 1" thru 6".

TYPE 657–SAUNDERS

Fisher operator on Saunders patented valve is widely used on "hard to handle" fluids which are viscous and/or corrosive. Available in wide variety of materials in sizes ½" thru 6".

Special design bodies for process services

Wide selection of sizes and available in all castable alloys

Supplied with improved diaphragm operator that provides accurate valve response

FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA

CANADIAN PLANT: WOODSTOCK, ONTARIO

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

DIESEL ENGINE TROUBLE CHART

POOR COMBUSTION:

Possible Cause

- Wrong fuel
- Wrong injection timing
- Sediment or slugs of water in fuel
- Leaky injection valve
- Carbon on injector
- Overheated injector
- Improper size orifice
- Subnormal compression temperature
- Injector valve sticking
- Weak injector valve spring
- Air in fuel lines
- Incorrect valve timing
- Leaky valve or valves
- Stuck piston rings
- Subnormal water jacket temperatures
- Worn cylinders
- Intake or exhaust ports clogged (2 cycle engines)
- Light loads
- Cold intake air
- Overlubricated cylinder walls

EXHAUST SMOKE:

Possible Cause

- Weak compression
- Sticking or worn nozzle
- Cetane fuel too low
- Excessive amount of oil reaching combustion chamber
- Unequal power output of cylinder
- Dirty air filter or silencer
- Misfiring
- Leaky inlet or exhaust
- Inadequate air supply
- Sticky or worn piston rings
- Inlet air or jacket water too cool
- Worn or scored cylinders

HIGH OIL TEMPERATURE:

Possible Cause

- Overheated bearing surfaces
- Not enough oil in circulation
- High water jacket temperatures
- Crankcase insufficiently cooled
- Plugged oil cooler
- Oil badly contaminated
- Late combustion
- Overloading

ENGINE OVERHEATS:

Possible Cause

- Lack of cooling water
- Incrustations in water jacket
- Obstruction to circulation of the water
- Damage to water pump
- Fuel injection too late
- Inadequate lubrication

CYLINDER WEAR:

Possible Cause

- Corrosion caused by water from products of combustion or by leaky head gasket
- Abrasive material from dust in air
- Sulphur loaded fuel
- Insufficient or incorrect oil
- Overheating
- Blow-by
- Frequent cold starts
- Piston ring pressure too high
- Misaligned connecting rod
- Cylinder distortion

HIGH OIL CONSUMPTION:

Possible Cause

- Loose bearing fits (in pressure system)
- Excess oil reaching cylinders
- Bearing end play excessive
- Plugged oil wiper rings
- Oil pressure too high
- Oil diluted with fuel
- Oil leaks
- Piston rings not fitting properly
- High oil temperature

CITIES SERVICE C-300 DIESEL OIL: ANSWER TO MANY PROBLEMS!

As is evident by the chart, many problems experienced with diesel engines can result from insufficient lubrication or the use of an unsuitable oil.

To avoid these problems before they begin, an increasing number of diesel operations have switched to Cities Service C-300 Diesel Oil. The reason: Cities Service C-300 is made from the finest base oils to conform to Military Specification MIL-0-2104A . . . is high detergent and high dispersant . . . strongly fortified against oxidation and corrosion.

But results are what count and here are the outstanding results reported by users of Cities Service Diesel Oil. Says a leading power plant: "We get 23,205 brake horsepower hours per gallon of lube oil." Says another: "Engine compressions are the same after four years as after three months; liners worn only .0015"." And still another reports over 30,000 hours of use on its Nordbergs—six years without any appreciable wear using Cities Service Diesel Oil!

In short, users are unanimous in praising Cities Service Diesel Oil as the finest they've ever used. Try it and you'll agree. Talk with your nearby Cities Service Lubrication Engineer. Or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

COMBUSTION CHAMBER DEPOSITS:

Possible Cause

- Dust from air
- Imperfect combustion
- Unsuitable oil

ENGINE ROUGHNESS:

Possible Cause

- Imperfect injection
- Cetane number of fuel too low
- Injection timed too early

SUDDEN STOPPAGE:

Possible Cause

- No fuel
- Water or air in fuel line
- Too heavy fuel
- Dirt or gum in fuel
- Plugged fuel line
- Lubrication failure
- Overheated engine
- Seized or tightened moving part of engine

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HEATING, VENTILATING

1 **"Radiant heating construction"** is title of 8-p bulletin. Contains sketches showing position of wrought iron pipe coils in the concrete slab, relation of coils and slab to structural features of both on grade and above grade construction. A M Byers Co, Box 1076, Pittsburgh 30, Pa.

2 **Axial fans.** Illustrated 36-p bulletin B-1013 describes *Series 203* axial fans for ventilation, process air supply and process air recirculation applications. Both tubeaxial and vaneaxial flow principals are discussed. American Blower Corp, Detroit 32, Mich.

ELECTRICAL EQUIPMENT

3 **Industrial lighting.** Illustrated bulletin contains a summary of eight basic advantages of using mercury vapor lamps in industrial plants. It discusses proper use of high-bay reflectors and tells various ways to meet color requirements. Sylvania Electric Products, Inc, 1740 Broadway. New York 19, N. Y.

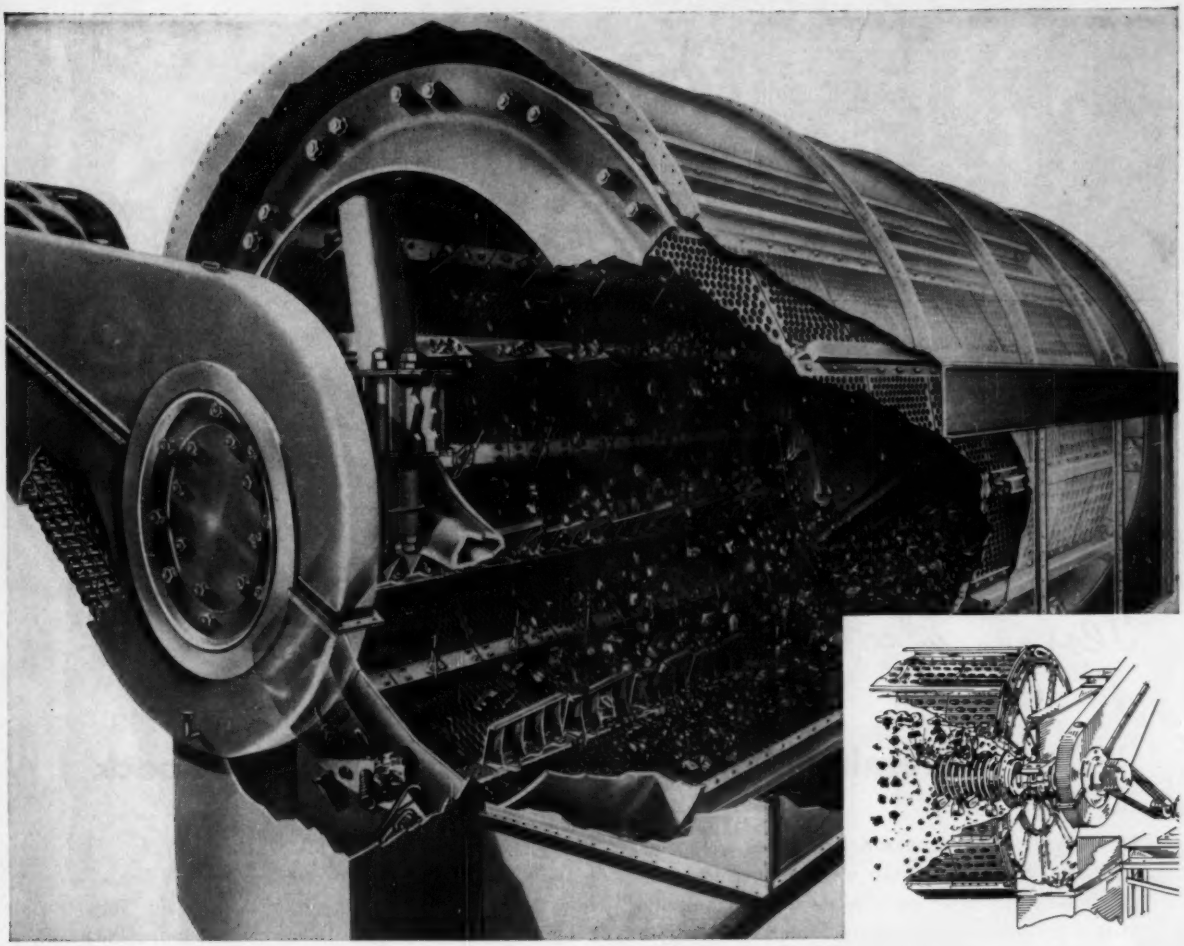
4 **Lighting data** on latest types of industrial lighting units is featured in 1956 edition of RLM Specifications Book. Contains new coefficient of utilization tables for eight different incandescent and fluorescent lighting units. RLM Standards Institute, 326 W Madison St, Chicago 6, Ill.

5 **Distribution regulators** are described in illustrated 16-p bulletin 21B7977A. Includes data on construction features, full specs and standard accessories. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

6 **Distribution transformers,** single-phase conventional type, 167 kva and below, are subject of illustrated 8-p bulletin CS-201. Kuhlman Electric Co, Bay City, Mich.

7 **Weather-protected motors** for outdoor installation are described in illustrated 6-p bulletin 05B7874B. Cross-section diagram shows mechanical features of a typical 700-hp, 2300-volt, 1185-rpm squirrel-cage induction machine. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

8 **Control, transfer switches** for low-voltage applications up to 600 volts ac or dc are described in 28-p bulletin GEA-4746B. Includes photos, drawings, application data, representative contact diagrams. General Electric Co, Schenectady 5, N. Y. *(Continued on page 224)*



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ALL IN ONE OPERATION

Bituminous coal, soft, medium and hard, from all sources, is easily and efficiently crushed at all times of the year by the Pennsylvania Bradford Hammermill, using only a small amount of power. The Pennsylvania gives you a uniform product, with no oversize and a minimum of fines. And this isn't all. You also get automatic removal of all refuse larger than the perforations in the breaker cylinder. This scavenging feature is a great protector of equipment following the breaker. Another point to remember, is, that, self-housed, no expensive building is needed to house this breaker. These are some of the reasons why Pennsylvania Bradford Hammermills have been preferred by power stations since 1921, crushing, sizing and scavenging over 70 million tons of coal per year. If you have very high capacity requirements we recommend the Pennsylvania Peripheral Feed Bradford Hammermills. Two of these Peripheral Feed Breakers will do the work of three of the conventional Bradfords.

PENNSYLVANIA

BRADFORD HAMMERMILLS

PENNSYLVANIA CRUSHER DIVISION

Bath Iron Works Corporation • West Chester, Penna.

PE-225

George Edwards

reminds us that we can't turn the clock back

► A COUPLE OF WEEKS AGO I missed a train connection and had a two-hour wait. A blustery wind and several inches of snow made it easy to decide to hole up in the warm waiting room. Just before leaving home I had put my latest copy of *Business Week* in my suitcase, so I settled back to catch up with the world.

Normally, it doesn't bother me if people around me are talking while I'm reading. But two men sitting back of me were discussing "scientific research" and "philosophy" and I couldn't concentrate. What they were saying sounded interesting —so I eavesdropped.

They disagreed on the meaning of the word *theory*. One man insisted that "scientific research is based on theory." To prove his point, he quoted from Sir John Herschel's *Natural Philosophy*. I looked up this book later and found it was written a hundred years ago. He also quoted from William Whewell's *Philosophy of Inductive Science and Discovery*, saying, "Theory and fact are necessarily considered as being of opposite natures, yet necessarily identical, and constituting science by their identity."

The other man would have none of this. "No," he said, "you use the word *theory* when you really mean *hypothesis*. A hypothesis," he went on, "may or may not turn out to be true, but a theory must, of necessity, be true. It's this lack of distinction between theory and fact that's characteristic of the practical man."

I hadn't turned around to look at them, but I felt sure these men were prominent in their fields. The scholarly tone of the discussion really impressed me and I hoped we were waiting for the same train. I'd try to get a seat near them. What they were saying didn't jibe with what I've been taught and I wanted to hear more of this debate.

Then I heard a voice say, "Sorry, boys, but you'll have to move along." The railroad policeman must have mistaken the look on my face as I turned for he said, "I hate to do it, especially in this weather, but I don't have any choice."

I watched the men shuffle to the door. Unshaven, poorly clothed, down at the heel, they went out into the snow.

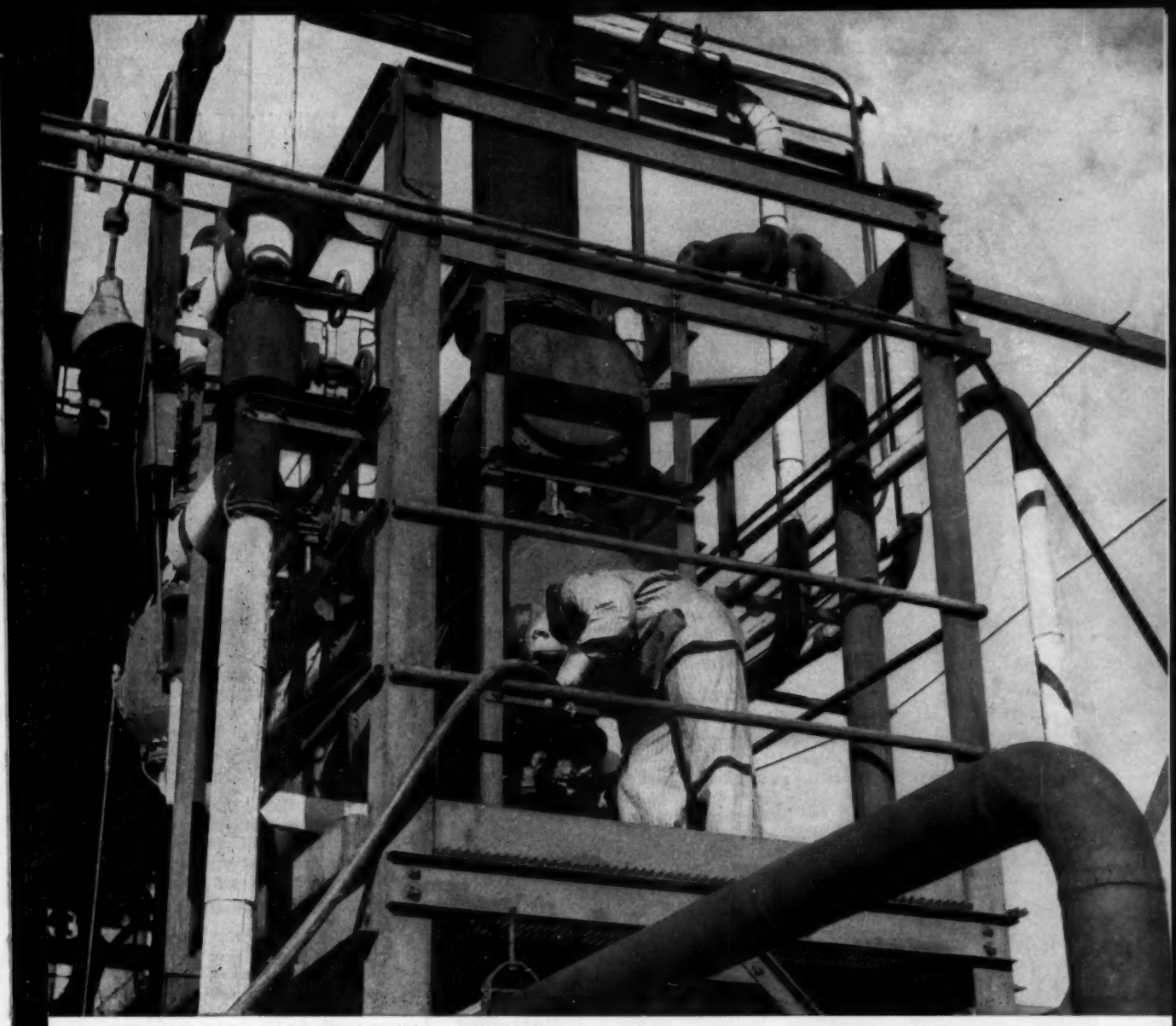
I stared at the door a long time. Two men, who must have been well educated, who could have been talking comfortably in a university club, being tossed out of a railroad station. How come?

Somehow, during their lives, these men had stalled. Or could it be they never got up enough steam to overcome inertia and power them beyond wishful thinking?

A good many of us are guilty of this to some degree. We do a lot of talking, but we just never get around to the action stage. It's habit-forming —and can lick us if we let it.

John Greenleaf Whittier pretty well summed it up for us in *Maud Muller*:

"For of all sad words of tongue or pen,
The saddest are these—it might have been."



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Furthermore, Dowell engineers know you value the safety of your men and equipment. Dowell uses only the latest safety equipment and techniques to eliminate hazards and accidents. Our engineers work closely with your safety personnel to establish the safest possible working procedures.

Call the nearest of more than 165 Dowell offices. An experienced engineer will be glad to talk over and help you with your cleaning problems any time — at no obligation. Or write Dowell Incorporated, Tulsa 1, Okla. Dept. E-23.

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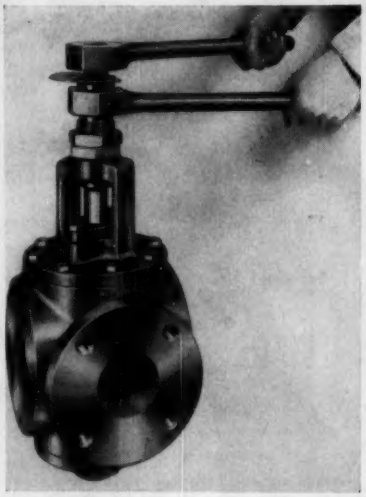
Los Angeles
Fred S. Renauld & Co., 1014 W. Eighty-Fourth St. • Pleasant 2-6181

More EQUIPMENT NEWS

Begins on page 158



Semi-steel plug valve

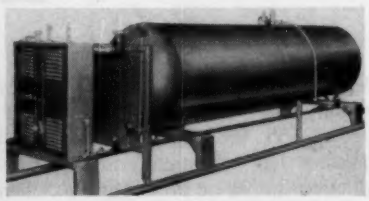
519 • Abrasive slurries and solids in suspension—cement, sand, coal, food products, plant waste and chemical sludges—as well as oil, gases and chemicals, are handled by this plug valve. Construction is somewhat similar to the simple plug valve, except that seating force on the plug is applied manually. Turning torque is said to be very low since the plug is turned only after being raised from its seat. Plug is coated with synthetic rubber which provides a leakproof seal. Oil or grease is unnecessary for sealing or to reduce friction. Absence of lubricant means there is no contamination of the products passing through the valve.

Valve is actuated by two handles: A quarter turn of the lower handle raises plug from its seat, providing clearance that eliminates friction and wear between seat and plug. While raised it is turned with upper handle for the desired flow pattern.

Valve is built of semi-steel. Shaft is packed; body is sealed with O-rings. Heavy flanges extend the service range up to 200 psi. Further details on request.

Republic Mfg Co, 15655 Brookpark Rd, Cleveland 11, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.



Propane standby plant

518 • Package plant is designed to supply propane gas for heat treating, gas cutting and other industrial uses. Primarily a standby unit, used when supply of city or natural gas is cut off, the plant has been constructed for easy portability.

Vaporizer, tank and controls are mounted on heavy metal skids. Provision has been

"Used many makes of turbines... PREFERS COPPUS"

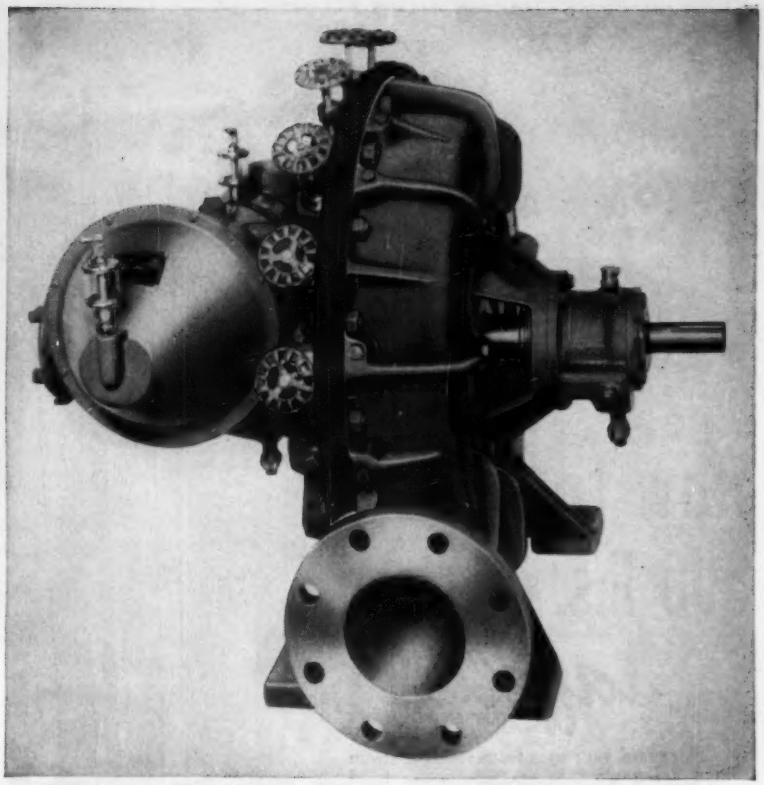
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
165 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

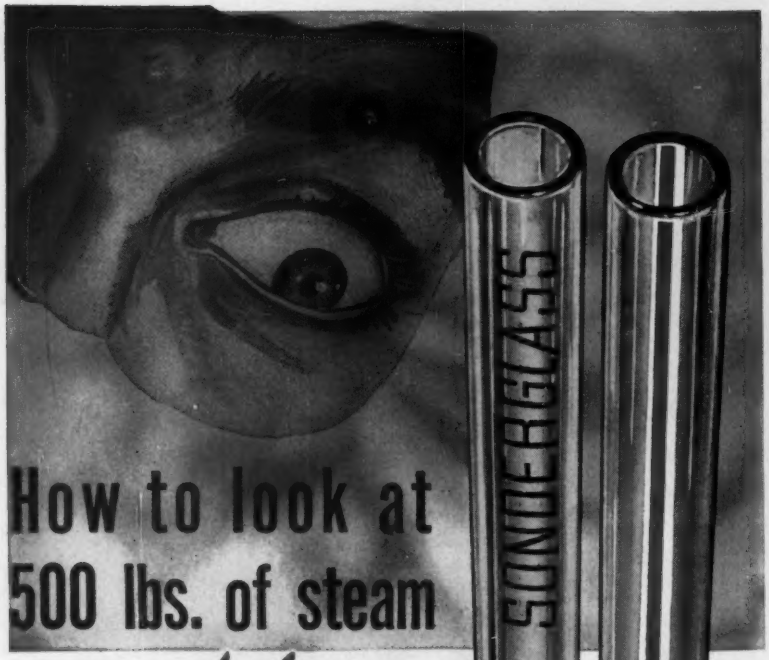


This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.

This wide bucket "L" type wheel is a new development for use where low water rate is essential.

This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

COPPUS "BLUE RIBBON" TURBINES

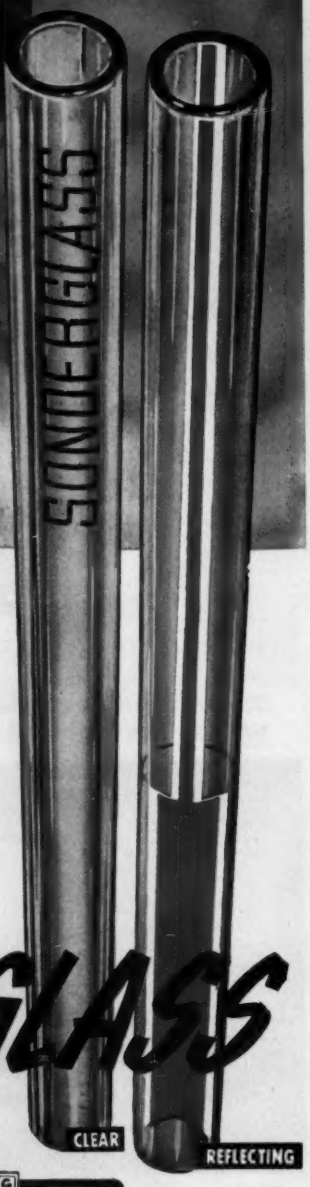


How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.



SONDERGLASS

THE SAFE GAUGE GLASS

PACKING
Chesterton
SERVICE

NEW PRESSURIZED SPRAGRIP

First Effective Treatment for V Belts

Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.

More EQUIPMENT NEWS

Begins on page 158

made so that the standby unit can be quickly substituted for the main source.

Submerged Combustion Company of America, Inc, Hammond, Ind.

Insulating castable

532 • High-temperature insulating castable, known as *Alundum 33-1*, is effective in providing insulation against temperatures up to 3300 F, according to manufacturer. Suggested applications include back-up insulation for kilns and furnaces, back-up for pit furnace linings, high-temperature burner ports, insulation for chemical furnaces and other applications where high-temperature insulation is a must.

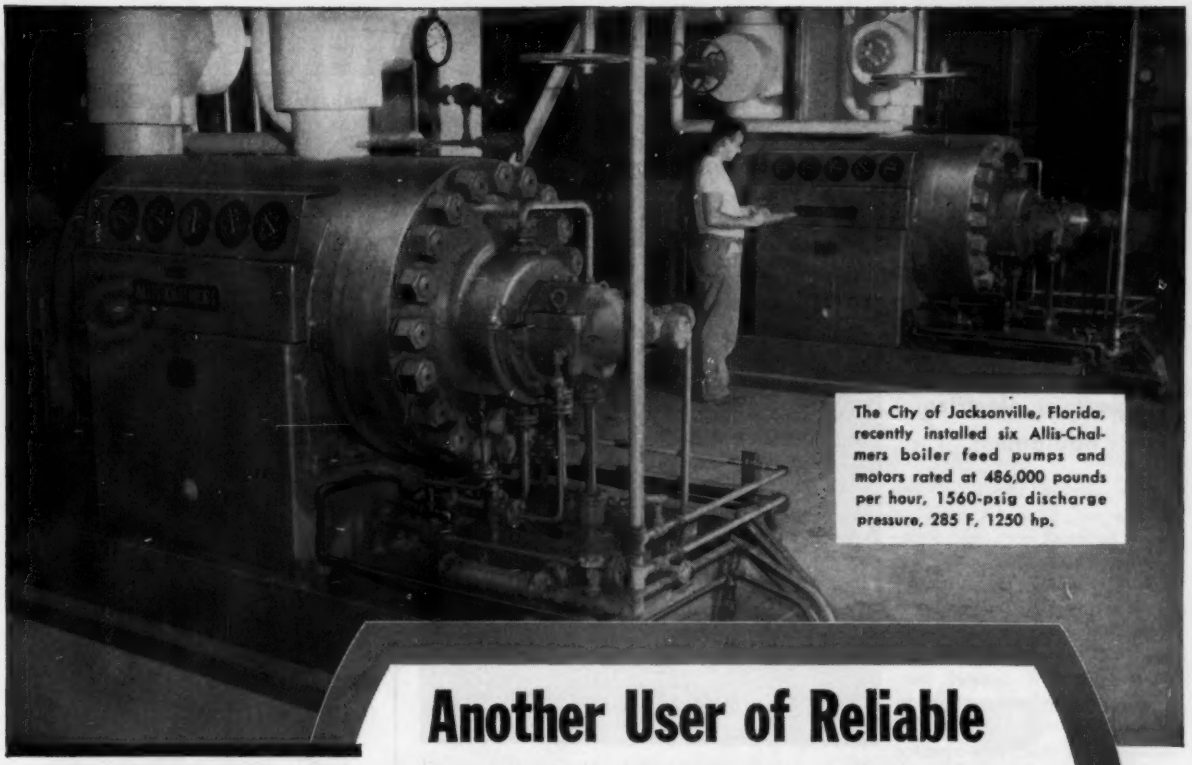
Alundum 33-1 is lightweight and monolithic in structure having an aluminum oxide content of about 96%. It is made up of pure alumina bubbles in the range of six mesh and finer. Further details on request to the manufacturer.

Norton Co, Refractories Div, Worcester 6, Mass.

For more data on these items, use post cards p 167. Identify your request with item number.

Automatic floodlight

522 • Light goes on instantly when it gets dark and shuts off automatically at day break, or when regular lights are switched on. It can be plugged into any standard outlet—mounts in any position. Suggested uses are for burglar protection, fire protec-



The City of Jacksonville, Florida, recently installed six Allis-Chalmers boiler feed pumps and motors rated at 486,000 pounds per hour, 1560-psig discharge pressure, 285 F, 1250 hp.

Another User of Reliable ALLIS-CHALMERS barrel-type PUMPS

City of Jacksonville

Here are the reasons **for wide acceptance of these pumps:**

- Outstanding performance — fully proved by service records.
- High efficiency and smooth operation under fluctuating loads — first stage has twin, single-suction impellers for low NPSH requirements.
- Simple maintenance—expansion joint and shaft seals are brought to outside of pump where they can be easily inspected.
- No balancing device needed—axial balance is maintained by back-to-back mounting of the impellers.

THERE are outstanding features like these throughout the Allis-Chalmers line. Whether you require boiler feed, condensate, circulating or other power plant pumps — it pays to standardize on Allis-Chalmers.

In addition, A-C can supply pumps, motors and control of coordinated design and manufacture. This means one responsibility — one guarantee of satisfaction.

Get complete information on barrel-type boiler feed pumps. Call your nearby A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin for Bulletin 08B7899.

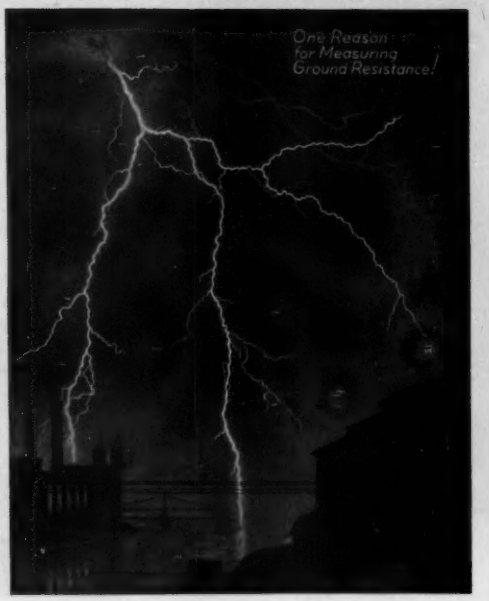
A-4854

ALLIS-CHALMERS

BIDDLE *Instrument News*

IT TAKES ONLY ONE STRIKE

. . . to knock out important electrical equipment



The season for electrical storms will soon be with us again in many sections of the country. The insidious thing about lightning is that it strikes at your plant's power system. Nine-tenths of the industrial damage it causes is to vital electrical equipment—motors, generators, transformers—or to power house chimneys. But this damage is of small consequence compared to the loss of power and stoppage of production. To prevent such losses, ground connections on lightning rods and arresters must be kept in good condition.

Test Grounds Once a Year

Properly installed and grounded lightning arresters are the first line of defense in protecting important electrical equipment such as generators, switchboards and transformers from lightning damage. Similarly, factory stacks are less subject to damage if protected by lightning rods and conductors that permit the stroke to pass harmlessly to earth.

In spite of apparently good lightning rod or arrester protection, lightning frequently will cause severe damage if high ground resistance hampers its dissipation in the earth.

Experience has shown that ground resistance does not remain constant and that tests should be made at least once a year, and high ground resistance corrected.

"Megger" Method

This is the simplest, easiest, quickest and most accurate method of determining ground resistance, and should be used wherever possible. The "Megger"® Ground Tester is an instrument specially designed for this purpose.

By virtue of the Megger crossed-coil ohmmeter the Megger Ground Testers are *direct-reading* in ohms. The operator reads the resistance value from the deflection of a pointer over a scale, as simply and easily as reading a voltmeter. These results are secured with only *one set of connections*, in *one operation*, and *without any calculations*.

For measurements of ordinary ground resistance, two auxiliary or reference grounds are required; or, connection may be made to a water system or other metallic structure that is known or assumed to have zero resistance to earth. The ohmmeter then indicates the resistance to earth of the ground under test.

Resistance of Grounds Should Not Exceed 5 Ohms

If tests show the resistance to ground is over 5 ohms, the resistance should be reduced by connecting to underground water pipes, copper plates or driven rods.

Want Help on Grounding Problems?

Write for these bulletins:

Bulletin 25-J-P — A Manual on Ground Resistance Testing.

Bulletin 25T2P—"Grounding Electric Circuits Effectively"

Bulletin 25T4P—"Grounding Principles and Practices as Applied to Industrial Plants"

B-604

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

More EQUIPMENT NEWS

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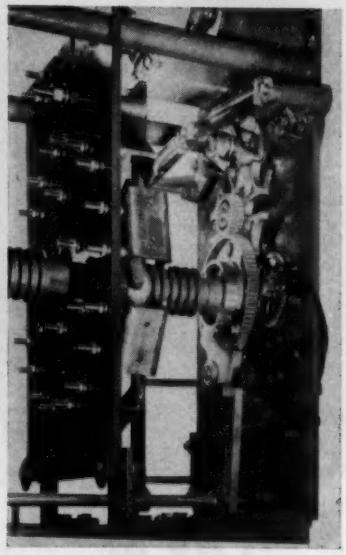
tion, safety, automatic night illumination, display purposes.

Protects a minimum area of about 10,000 sq ft. Complete operation cost is approximately two-cents a day, according to manufacturer. Full details on request.

Lite-O-Matic Co, 2271 E 14th St, Brooklyn 29, N. Y.



Load-tap-changing mechanism

533 • Redesigned mechanism is claimed to double contact life and cut peak operating noise of company's load tap changers used on medium transformers and small three-phase voltage regulators. Dashpots, above, act as hydraulic shock absorbers to slow up contact closure, minimize secondary arcing. Improved Geneva gear, center, lets driving pin enter gear exactly parallel to slot, reducing noise and wear. Switches, Geneva gear, springs and drive motor are immersed in oil in the same compartment. Tap changing compartment has a hinged door on the front for easy access and a nitrile rubber gasket for better seal against oil leakage. Full details from manufacturer.

General Electric Co, Schenectady 5, N. Y.

For more data on these items, use post cards p 167. Identify your request with item number.

Air-meter and probe

534 • Instrument is used in connection with smog, air pollution and other applications where extremely small air-flow measurements are necessary. With a range of 0 to 30 mph and a logarithmic-type

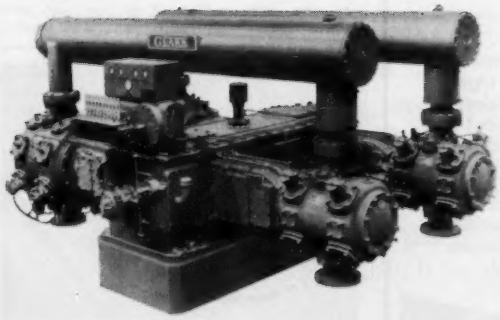
any flat means trouble

but in plant air supply it also means lost production!

Unless your plant air supply has adequate capacity in reserve, you may actually slow down your entire production every time you add a new labor-saving air-operated tool or device.

New increased demands on overloaded or overextended air supply inevitably cause a pressure drop all along the line. That means every tool, chuck and wrench slows down . . . and production suffers.

When did you last check your air at the *end* of the line? If it is going "flat," a Clark Balanced/Opposed Air Compressor will restore full pressure and, at the same time, *provide for a planned reserve to take care of future demand.*



There is a Clark Representative near you ready to give you all the facts. Why not call him now or write for your copy of Bulletin 118?

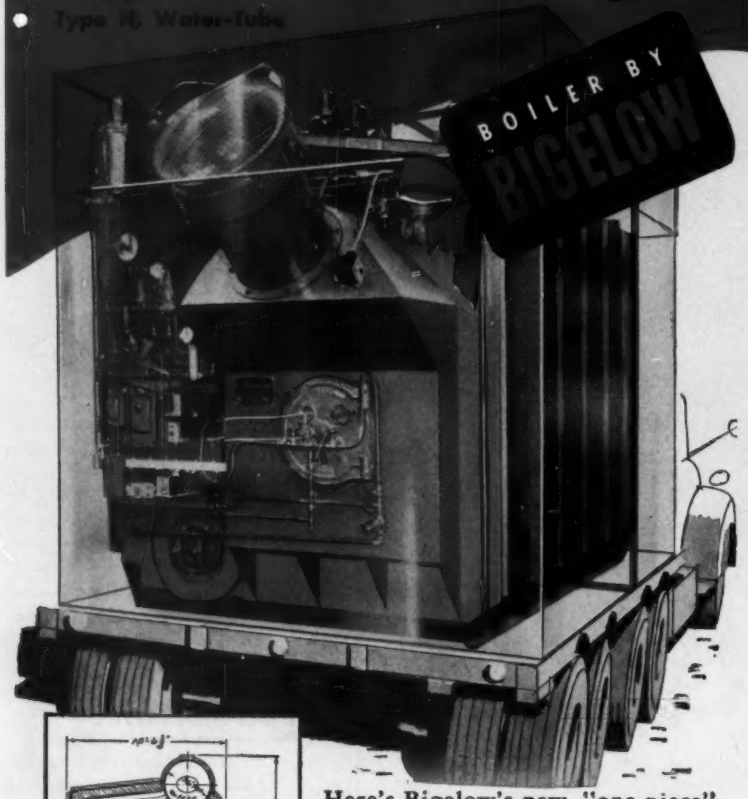
CLARK BROS. CO., OLEAN, N. Y.
One of the Dresser Industries
Offices in principal cities throughout the world

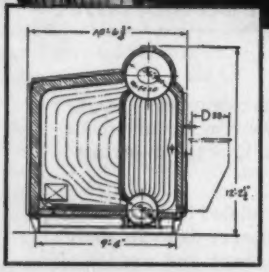
CLARK®

Balanced
Opposed
Compressors

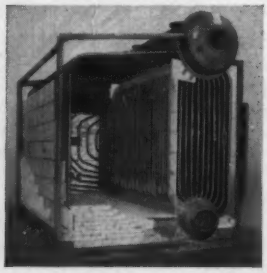
New Shop-Assembled Power Package

Type H, Water-Tube





Here's Bigelow's new, "one-piece" answer to a wide range of steam problems. This water-tube "packaged" boiler includes burner, forced-draft fan, feed water regulator, soot blower, valves, refractory, insulation, controls and accessory equipment. It is shipped complete—ready to operate as soon as service connections are made.



Type H boiler in process of shop assembly.

Advantages

Cuts Installation Costs and Time... Requires Small Space... Portable... Simple To Operate... Fast Steaming With Safety, Efficiency and Economy... Low Maintenance... Handles Quick Load Changes Easily and Efficiently... Wide Range Of Service... Burns Oil or Gas.

Available in standard sizes for capacities ranging from 8,000 to 30,000 lbs. of steam per hr. Write for complete catalog.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Orangeburg, S. C. • Philadelphia • Syracuse • Detroit • Washington, D. C. • San Francisco • Los Angeles • Atlanta • Milwaukee • New Orleans • Petersburg, Va. • Seattle • Indianapolis • Kansas City, Mo. • Tulsa • Salisbury, Md. • Greensboro, N. C.

More EQUIPMENT NEWS

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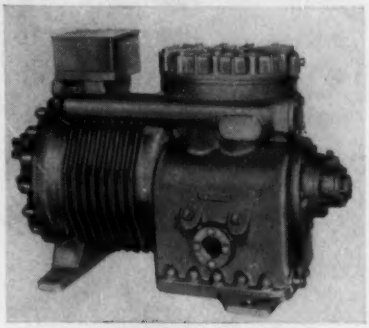
meter scale that provides expanded readings in the low-velocity range, the air-meter is said to assure excellent readability below 5 mph and unusual accuracy below 1 mph. Response time is less than one second.

The air-velocity measuring probe, which contains no moving parts, is horizontally nondirectional and is suitable for portable use or for fixed installation. The probe may be installed at a remote point from the indicator. The instrument can be used with a recorder to obtain permanent chart records. Further details on request.

Hastings Instrument Co, Inc, Hampton, Va.



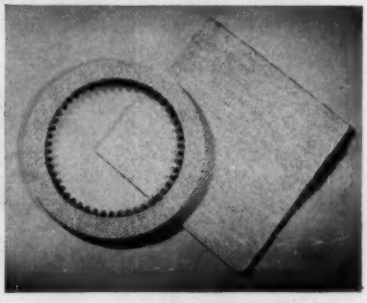
Gas-cooled compressor

530 • Suction gas cooled 10-hp unit is designed for air-conditioning applications. It measures 27 3/16-in. long; 18½-in. high (on springs) and is 14-in. wide. Displacement is 1375 cfh at 1750 rpm; refrigerant is F-22.

Use of refrigerant to cool motor windings eliminates compressor cooling fans or water connections for a completely waterless installation. Compact design permits installation in packaged or remote air-conditioner condensing units in the 10-hp size. Can also be used in combinations for packaged air conditioners of virtually any size, according to manufacturer.

Copeland Refrigeration Corp, Sidney, Ohio

For more data on these items, use post cards p 167. Identify your request with item number.



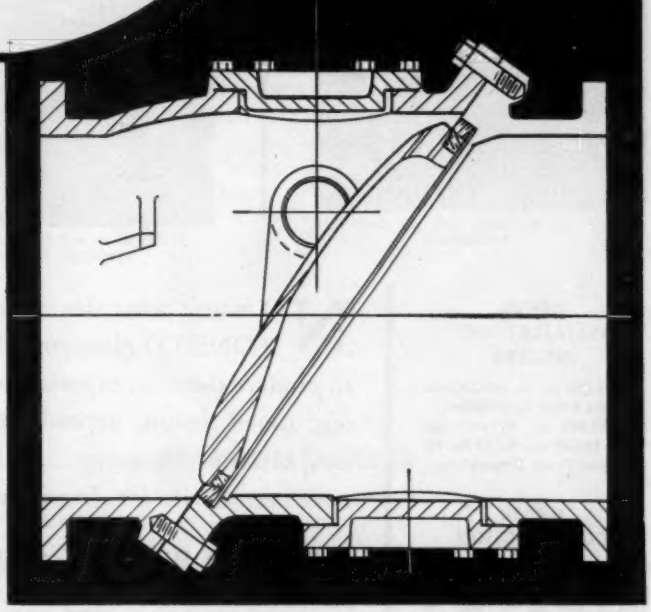
Asbestos friction material

531 • A series of friction materials of woven asbestos fiber impregnated with various oils and resins has been developed for use with oil-cooled power-transmission equipment.

The non-metallic fabric is designed to be

CHAPMAN TILTING DISC CHECK VALVE

the Valve with the Right Idea!



Here is a cross section of top check valve performance at lowest cost. It's the idea in back of Chapman's Tilting Disc Check Valve . . . the valve that's designed to go with the flow.

When the flow is on, specially designed "airfoil" disc balances perfectly in open position. Fluid holds it tightly against stops. There's no vibration . . . no flutter. It's quiet. And note the design. Ample room is allowed around disc to assure low flow resistance.

When the flow is reversed, disc drops surely, quietly, *tightly* on special beveled seat. There's no banging, no slamming, no scraping or wearing of disc and seat faces, no damage to piping joints or the valve itself. It's as simple as that. It's as *sound* as that. It has the right idea.

Complete information on these rugged, quiet, long life check valves is highlighted in our Catalog 30-A. Whether you want iron or steel construction . . . whether you handle fluids or gases under a wide range of pressures . . . this catalog gives you all the facts. Send for your up-to-date copy, today.

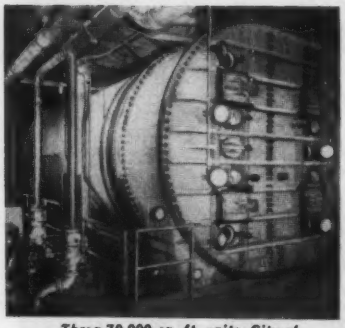
The CHAPMAN VALVE Mfg. CO.

INDIAN ORCHARD, MASS.

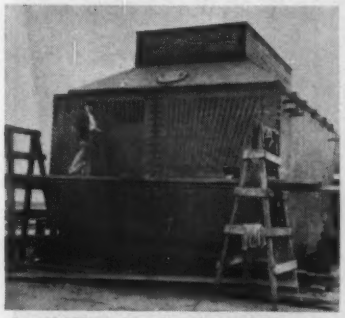
The BIGGER the BETTER

CONSECO

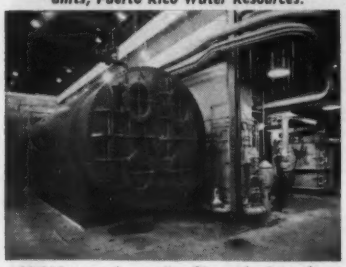
CONDENSERS



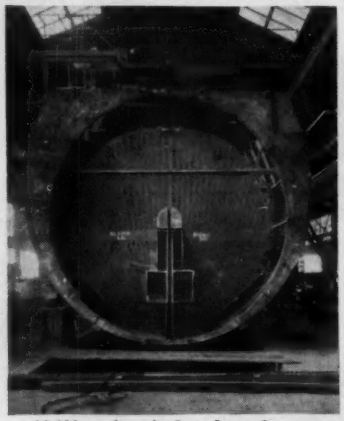
Three 70,000 sq. ft. units, City of Los Angeles, Cal.



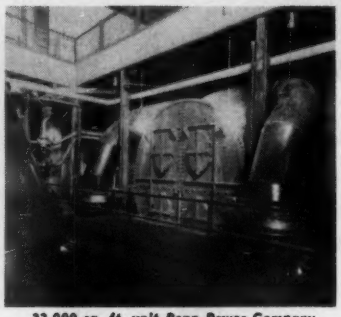
One 45,000 sq. ft. unit and two 20,000 sq. ft. units, Puerto Rico Water Resources.



28,000 sq. ft. unit, City of Owensboro, Kentucky.



33,000 sq. ft. unit, Penn Power Company, Newcastle, Pa. Under Construction.



33,000 sq. ft. unit Penn Power Company, Newcastle, Pa. Installed.

OTHER INSTALLATIONS INCLUDE

One 30,000 sq. ft. unit, Northern Sate Power Corporation.
One 35,000 sq. ft. unit and three 12,000 sq. ft. units, for Dairyland Power Corporation.

UNDER CONSTRUCTION

One 45,000 sq. ft. unit for Transit Authority, N. Y. C.
One 35,000 sq. ft. unit for Maryland Power Corporation.
One 27,000 sq. ft. unit for City of Detroit, Michigan.

NO matter what size units you need, CONSECO gives you what it takes to produce them . . . experienced engineering, sound design, dependable manufacture, better performance . . . at lowest ultimate cost. *Write for descriptive Bulletin.*

CONSECO DESIGNS AND BUILDS

Heat Exchangers • Condensers • Evaporators • Steam Jet Air Ejectors • Steam Generators • Pressure Vessels • Centrifuges Filters • Strainers • Pumps • Instruments and Specialties.

9

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

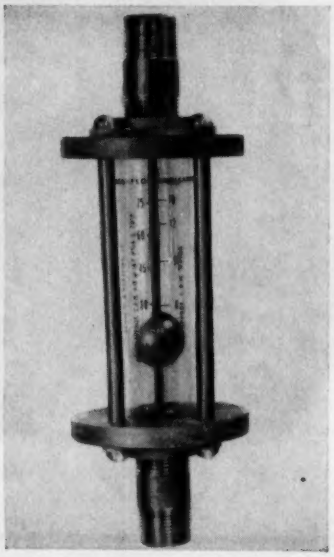
164 OBSERVER HIGHWAY
HOBOKEN, N. J.

More EQUIPMENT NEWS

Begins on page 158

bonded to metal plates with thermosetting resins and assembled in oil-cooled units alternately with metal pressure plates. Thickness of the material ranges from a minimum of .030 in. to a maximum of .090 in. in increments of .010 in. One piece, full ring diameters are available up to 12-in. OD. Any normal pressures encountered in oil-cooled power transmission equipment can be sustained by the fabric.

Thermoid Co, Friction Div, Trenton, N. J.



Ball-type flow indicator

535 • Indicator provides a dual scale for approximate measurement of water flow in gpm and air flow in cfm. It uses a ball on a guide rod, installed in a tapered glass tube, to indicate flow in a pipeline. When fluid, water or air flows from inlet at bottom to outlet at top it exerts force on the free moving ball causing it to rise in the tapered tube—higher as rate of flow of the fluid increases. Position of the ball in relation to scale graduations gives an approximate indication of fluid rate of flow.

The indicator is recommended for use when flow is from one direction only—bottom to top in vertical pipelines—and when observation from any direction is desired. For further information request bulletin 18W from the manufacturer.

Schutte & Koerting Co, Dept M-F, Cornwells Heights, Bucks Co, Pa.

For more data on these items, use post cards p 167. Identify your request with item number.

Pipe-joint cement

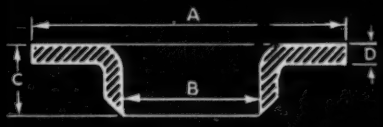
520 • *Stay-Tite* pipe cement provides lubrication as well as a permanent seal against leaks, according to manufacturer. Retaining its sealing qualities indefinitely, the cement remains in a plastic state after being applied. Fittings can be removed at any time without breakage.

Features claimed are: good consistency; prevents friction when joint is made up;

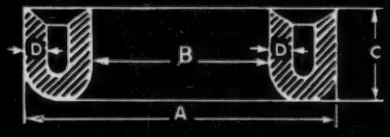
MOLDED CUPS, FLANGES, "U" PACKINGS

from accurately dimensioned molds to assure BETTER SERVICE!

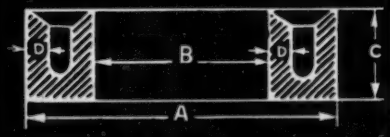
"CUP" Shaped



"FLANGE" Type



Round Bottom (R) "U"



Flat Bottom (F) "U"

"U" Shaped

OUR OWN SPECIAL COMPOUNDS AND DESIGNS

Anchor molded cups, flanges and "U" packings are formed in accurately dimensioned molds, made with special compounds ranging from natural rubber to the most appropriate synthetic rubber, all assuring long life and low friction.

Molded parts are used on a variety of equipment, packing against oil, solvents, air, water, gasoline.

Style 11 is made from strong cotton duck frictioned with an oil and solvent resisting compound. Recommended for high pressure oil, water, gasoline, etc., on presses, pumps, clutches, welding equipment, lifts, jacks, etc. Also on air where rapidity of stroke will require packing with a low coefficient of friction.

Style 43 Flexible type is a softer grade — better where flexibility is essential. Recommended for equipment requiring a very sensitive packing to insure a positive seal on air, oil, water, etc. . . . also recommended for equipment with mechanical irregularities such as slightly worn, scored, and remachined cylinder rods.

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GENERAL OFFICES: PHILADELPHIA, PA.

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Try ROTOJET®

Rotojet Tube Cleaners, driven by air, steam or water, are made for straight or curved tubes and pipes from ½" to 12" I.D. Send us your problem.

ELLIOTT COMPANY - ROTO DIVISION
Tube Cleaner Specialists Since 1910
153 Sussex Avenue, Newark, N. J.

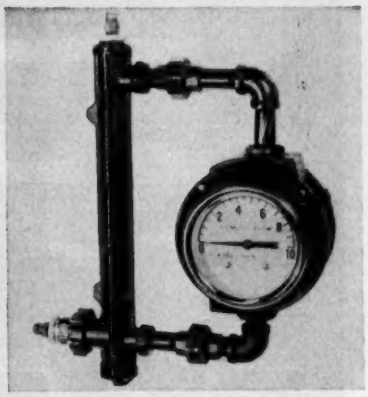
More EQUIPMENT NEWS

Begins on page 158

compensates for tool marks, imperfect thread or other surface irregularities; protects threads from rusting; flows on smoothly and evenly.

The cement may be applied to either high- or low-pressure piping used for such purposes as hot or cold water, steam, air, oil, gasoline and gas—including butane or propane. Request details from company.

J A Sexauer Mfg Co, Inc, Dept 23, 2503-05 3rd Ave, New York, N. Y.



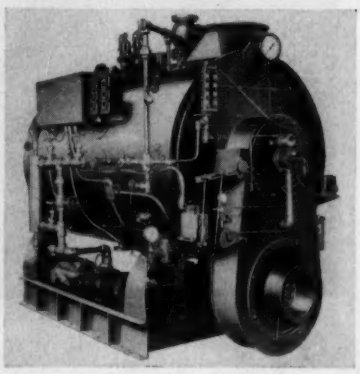
Vane-type flowmeter

524 • Vane-type flowmeter for air or gas flow is designed for a constant pressure drop across the meter. It may be used for indicating, controlling, signal alarm, safety shutoff, sequence starting or shutdown and similar applications.

As vane rotates with increase in flow, area between the end of vane and flexible spline in the meter body increases. This increase approximates the law of squares to provide pointer stability and an easy-to-read scale. By varying weight of the vane, and the area, various capacities can be produced. Complete details on request.

Scully-Jones and Company, 1901 S Rockwell St, Chicago, Ill.

For more data on these items, use post cards p 167. Identify your request with item number.



Marine-type steam generator

525 • A dry-land adaptation of company's marine steam generator makes it possible to obtain 5000-lb steam per hr from an over-all floor area 8 x 7 ft. The boiler stands only 7-ft high—making it possible

Here's The Most Versatile Pilot Ever Offered!

BS&B Universal Control Pilot With Type 73-26 Instrument Air Regulator.

It's The New BS&B Universal Control Pilot

For . . . ● Temperature Control ● Pressure Control ● Liquid Level Control

FEATURES

- ✓ **Linear Response.**
- ✓ **Factory Calibration.**
- ✓ **Excellent Frequency Response.**
- ✓ **Micrometer Adjustment.**
- ✓ **Outstanding Performance Repeatability.**

This trim modern-looking weatherproof aluminum case houses the new BS&B Universal Pilot—one of the simplest, yet most versatile control pilots you've ever seen!

Only 8" x 8" x 4" in size, this pilot offers a wide throttling range and high-low snap-acting settings without additional parts. Feed orifice has a push-button cleanout. All parts in the lower half of the case including the stainless steel power unit, micrometer adjusting nozzle, compensating bellows, proportioning band and gauges are common to all three types of service, and are interchangeable to reduce maintenance cost and inventory. Where regulator is required, the new BS&B 73-26 is provided to furnish a finely filtered supply of air or gas.

The pilot unit is equally adaptable to wall mounting, remote mounting, yoke or diaphragm mounting, or flush instrument board mounting. An unusual feature, designed for your convenience, is the double-hinged door which opens from either side!

For Full Details On The BS&B Universal Pilot, Contact Your BS&B Representative Or Write To . . .

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.
Controls Division, Dept. 4-Q5
7500 East 12th Street • Kansas City 26, Missouri

SUPER SEAL No. 1 PLASTIC PACKING

Here is the answer to the plant operator's need for a completely satisfactory packing for temperature conditions up to 550°F. It is the finest sealing packing available. By itself —or in combination with a more dense packing—it is the perfect packing for use throughout the plant in condensate, boiler feed, heater drain, circulating and evaporating pumps.

Super Seal is a combination of non-frictional metal particles and asbestos fiber . . . graphite impregnated and bonded together with special resilient binders to meet specific service conditions. It contains no volatiles. Nothing can be squeezed out or driven off under heat. It will not dry out or harden.

Other types of Super Seal are available for handling acids, alkalis and solvents, also oil, distillates, fruit juices and similar services. Supplied in spirals, coils and die-formed rings to fit all stuffing boxes.

Have "John Crane" engineers recommend the style Super Seal Packing best suited to your service. Request catalog.

Crane Packing Company, 6430 Oakton Street, Morton Grove, Illinois, (Chicago Suburb).
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JOHN CRANE **CRANE PACKING COMPANY**
OFFICES IN ALL PRINCIPAL CITIES

More EQUIPMENT NEWS

Begins on page 158

to obtain 150 hp in less than half the space required for the average package steam generator, manufacturer states.

Oil pump set assembly is furnished factory-installed under the unit to save space and cut down installation cost. Water-treatment tanks are mounted on the side of boiler shell and piped to feedwater pump system. Bypass piping permits manually controlled water circulation.

Cyclotherm Division, National-U.S. Radiator Corp, Oswego, N. Y.

Handle-bar union

526 • Lightweight union is suited for production piping to 1000-lb cold-working pressure. The 5-in. height, 15-lb weight, 4-lug nut API threaded ends and an interchangeable factor combine to provide greater convenience and ease of handling for all types of piping problems, manufacturer states. Further details in bulletin 4-1000, available on request to company.

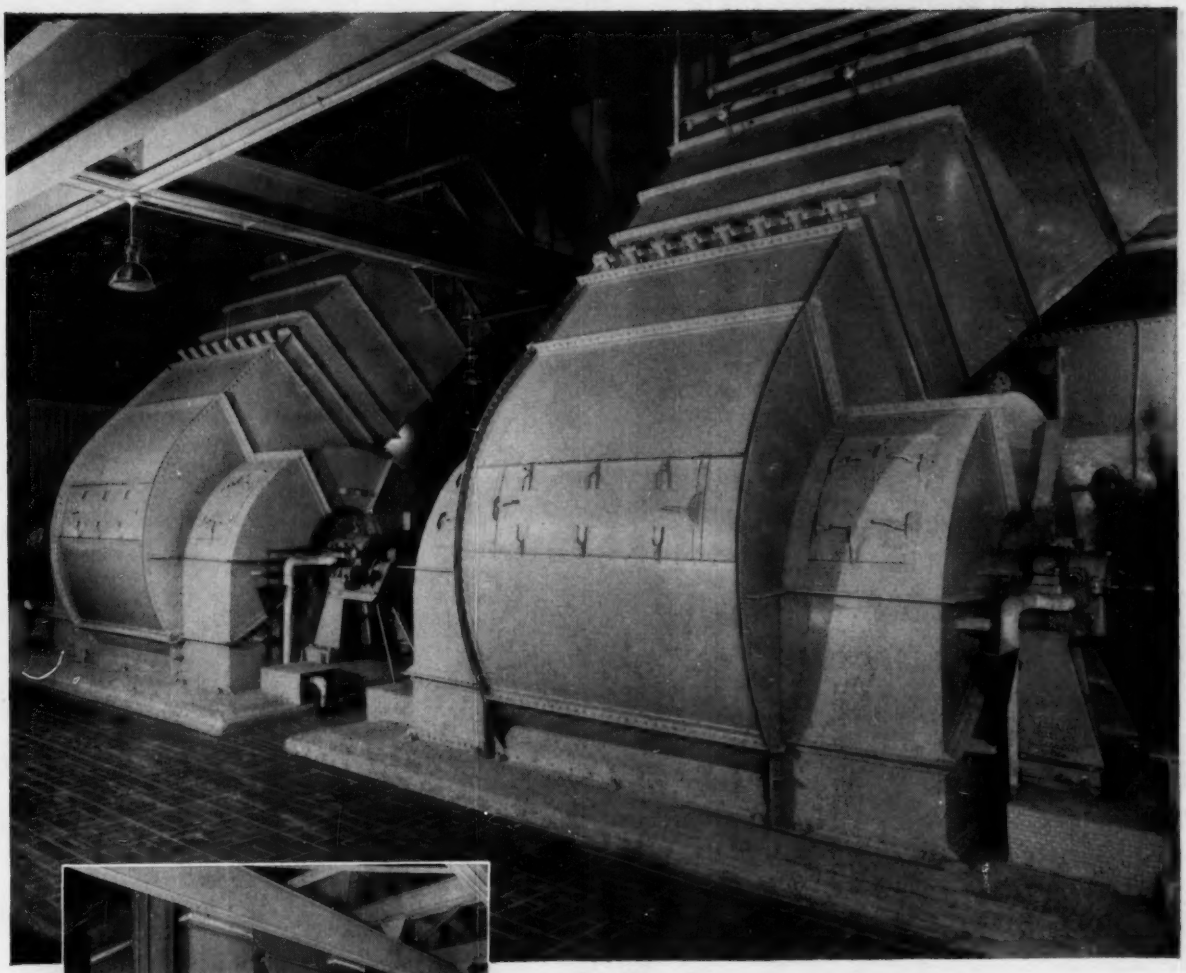
Clayton Mark & Company, 1900 Dempster St, Evanston, Ill.

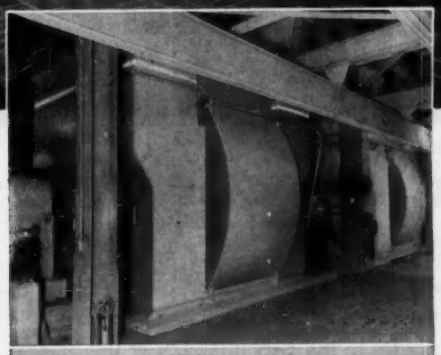
For more data on these items, use post cards p 167. Identify your request with item number.

Industrial oil burners

521 • Manufacturer states that these oil burners, ranging in size from 1 to 42 gph, incorporate electronic safety protection in excess of any code requirements. All are UL approved and listed. Burners with a bhp rating of 30 or more come factory equipped with two-stage high-low fire. Size ranges in bhp are from 7.3 to 125. Further details available on request to the manufacturer.

Synchronous Flame Inc, Walworth, Wis.





Top Photo: Two "Buffalo" Forced Draft Fans recently installed in a large Ohio Valley utility station. "Buffalo" outlet damper control.

Two "Buffalo" Induced Draft Fans in the same new power plant. These ruggedly built fans have both the endurance and high efficiency to provide the greatest draft economy.

another modern utility station using "Buffalo" fans

"Buffalo" Mechanical Draft Fans have always been the choice of leading utility stations, as well as industrial plants, because of their famous "Q" Factor* construction — the "Q" Factor of bonus strength, accessibility and outstanding efficiency. Their low maintenance costs and their economy of driving power combine to give the lowest possible draft costs. Thousands of "Buffalo" installations are proof of it.

And, to match the exact conditions under which you plan to operate, "Buffalo" offers you a complete choice of tested and proven blade designs — backward curve, our new deep-bite airfoil wheel, radial and forward curve blades.

Assure this important part of your power production—specify "Buffalo". Write for Bulletin 3750 or contact your nearby factory-trained "Buffalo" Engineering Representative.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

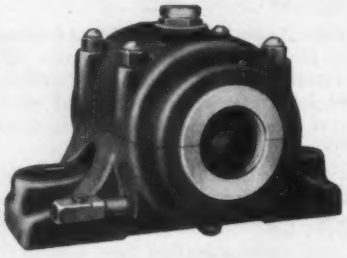
BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Bright Lights–That Never Fail



SLEEVOIL BEARINGS

Dodge Sleevoil Bearings are available in plain type, water-cooled, or air-cooled for outside use—all self-aligning—all drilled for thermostatic emergency warning. Shaft sizes from 1-7/16″ to 10″.

The brilliant lights of Broadway match the stars in the certainty of their rising. A black-out from power failure is almost unthinkable.

One factor that contributes to the dependability of this steady power supply is the bearing that insures unfailing operation of mechanized draft in the generating plant.

These Bearings are Dodge Sleevoil.

Generating plants throughout America—including those in such metropolitan centers as New York, Detroit, San Francisco, Los Angeles—use these super-quality bearings.

The Sleevoil Bearing is a Dodge development, created especially to meet the exacting requirements of fan and blower service. You are invited to write us for our new Engineering Catalog D56, which contains detailed description, sizes, dimensions.

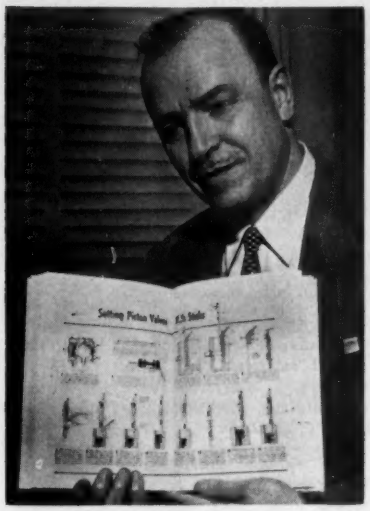
DODGE MANUFACTURING CORP., 3200 Union St., Mishawaka, Indiana

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on modern power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your classified telephone directory.

DODGE

of Mishawaka, Ind.

ENGINEER'S BOOKSHELF



HOT OFF THE PRESS! Steve Elonka holds copy of his new book, *Plant Operators' Manual*, containing 1539 illustrations

Plant Operators' Manual. *By Steve Elonka, associate editor of* POWER. *292 pp, 1539 illust, 6 x 9, hard cover, $5.00. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y.*

This well-illustrated book shows engineers, firemen, oilers, mechanics, and other power-service personnel how to maintain and operate their equipment. Material covered will help in license examinations and job upgrading and should prove a valuable aid to the student engineer.

Boilers, engines, turbines, pumps, compressors and similar equipment are covered. A wide range of practical material is provided, covering such jobs as setting valves, charging Freon compressors, overhauling bearings, timing and setting diesel valves. The 1539 illustrations included in the book show step-by-step procedures, making it one of the most easily understood references ever published.

Use of many of the latest instruments in the power field is included, such as the alignment telescope for aligning bearings, strain gage for crankshafts, reflectoscope for detecting cracks, dial indicators for aligning flexible couplings. Everyone in the power field should place this book on his "preferred reading" list.

Principles of Nuclear Reactor Engineering (1955). *By Samuel Glasstone, consultant, U S Atomic Energy Commission, with the assistance of Oak Ridge National Laboratory staff members: E E Anderson, E P Blizard, W K Eister, G E Evans, W H Jordan, J A Lane, N F Lansing, R W Stoughton, W H Sullivan, J D Trimmer. 6½x9, 861 pp, illust, tables, $7.95. D Van Nostrand Co, Inc, 250 4th Ave, New York 3, N. Y.*

Nuclear reactor engineering covers the design, construction and operation of reactors for energy production by fissioning of atomic nuclei. This book describes basic scientific principles underlying this field. While the principles are not complicated and pretty well understood, their application raises unique problems in respect to radiation and fissioning. Reactor engineering requires the cooperation of chemical, electrical, electronic, mechanical and other engineers with chemists, mathematicians, metallurgists, physicists and biologists.

The book will help individual engineers understand their relationship with the group as a whole. Each chapter introduces special design aspects, and specialists will be expected to build extended knowledge on these bases through practical experience. Engineers who wish to advance their knowledge of reactor engineering will find considerable help from this volume, as an introduction and a reference.

Chapter headings: Scope of nuclear reactor engineering, Nuclear reactions and radiations, Reactor theory—the steady state, Reactor theory—disturbance of the steady state, Nuclear reactor instrumentation, Control of nuclear reactors. Processing of nuclear reactor fuels, Nuclear reactor materials, Radiation protection, Shielding of nuclear reactor systems, Thermal aspects of nuclear reactor systems, Nuclear reactor design variables. Descriptions of nuclear reactors.

Professional Engineer's Examination Questions and Answers. *By William S LaLonde Jr, chairman of dept of civil engineering, Newark College of Engineering. 462 pp, 215 illust, $6.50. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y.*

With the questions and answers in this guide, candidates for engineering licenses get a close idea of what the real examinations are like and what they need to know to pass. The more than 500 questions included were drawn from recent actual examinations for Professional Engineer License, Land Surveyor License and Engineer-in-Training Certificate. For every question there is a detailed answer of the type examiners accept and credit.

Questions cover all major phases of professional engineering examinations—fundamental, chemical, civil, electrical and mechanical. Many are composites of the more complex questions found in examinations given throughout the U.S. Thus, with this guide the license candidate can prepare himself for his examination no matter what his field of engineering or in what part of the country he will take it.

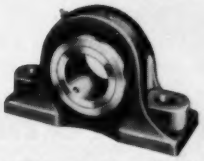
Diesel Engineering Handbook. (*Ninth edition*). *Edited by A B Newell, 6x9, 835 pp, 581 illust, $8.50. Diesel Publications' Book Division, 192 Lexington Ave, New York 16, N. Y.*

Completely revised, this edition comprises a comprehensive and up-to-date

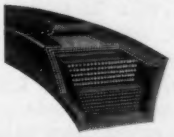
(*Continued on page* 188)

DODGE PRODUCTS you should know

TAPER-LOCK
ALL-STEEL
CONVEYOR PULLEYS



SC and SCM
BALL BEARING
PILLOW BLOCKS



SEALED-LIFE V-BELTS

DODGE BULLETINS YOU SHOULD HAVE

- TAPER-LOCK STEEL CONVEYOR PULLEYS. Construction details, sizes, dimensions. Bulletin D56.
- ROLLING BEARINGS. Load ratings, dimensions and other data on Dodge-Timken and SC and SCM Ball Bearings. Bulletin A638.
- SEALED-LIFE V-BELTS. Construction details and data on sizes, pitch lengths and outside lengths. Bulletin A-606.

Write for your copies.

DODGE MANUFACTURING CORPORATION
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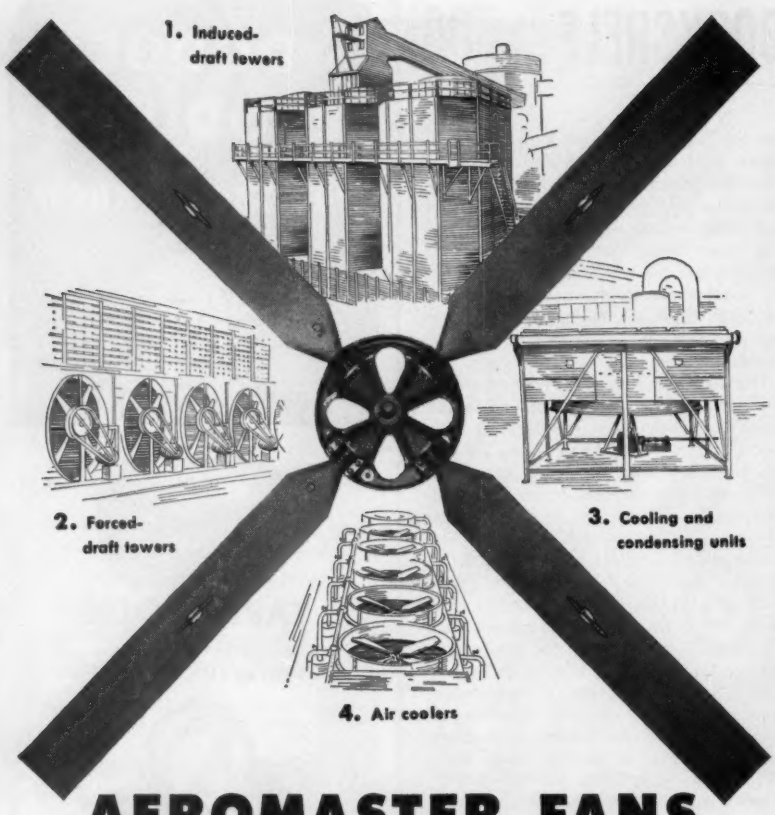

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First choice for all four

Ask the manufacturer . . . *ask the user* . . . what fan he prefers for his cooling equipment. Chances are he'll say Aeromaster.

Why? Because he knows from experience that Aeromaster Fans can be relied upon to give good service.

Aeromaster Fans are *precision-engineered,* adapted from high speed aircraft propellers. They have adjustable blade pitch and anti-flutter design . . . therefore, require less horsepower. And they last longer too, thanks to the exclusive Aeroloid blade coating to resist acids and alkalies, abrasion and weather. Overall result: Aeromaster Fans *give more cooling at lower cost.*

Available in 4, 6, or 8 blade styles, in diameters of 5 to 24 ft., with capacities up to 1,000,000 cubic feet per minute, all Aeromaster Fans are fully guaranteed.

Koppers also has trained engineering specialists available in principal cities, insuring prompt, expert Aeromaster Fan service. And Koppers is always ready to consult with you on special fan problems. Next time you plan a replacement of present fans, specify Aeromaster. When you consider new equipment, call on Koppers . . . always eager to be of service.

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Aeromaster Fans

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Gentlemen: Please send me detailed information on Aeromaster Fans for .....(name and type of equipment to be cooled).

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Title.....Company.....

Address.....

City.....Zone.....State.....

More BOOKSHELF

Begins on page 187

source of the latest in diesel engine design, maintenance and operation. It is written as a basic reference guide for the beginner or expert in all industries using, servicing or manufacturing diesel engines and accessories.

Over 900 separate diesel topics are reviewed. Its 30 chapters include items like fuel-injection systems, fuel oil, cooling systems, frame and cylinder maintenance, pistons and rings, crankshafts and bearings, valves, supercharging, lubrication, starting systems, diesels by make and type, and engine specifications on over 1100 makes and models.

ASTM Specifications for Steel Piping Materials. *Prepared by ASTM committee A-1 on steel. 6 x 9, paper, 425 pp, illust, $4.00. American Society of Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This volume contains the latest approved form of 58 ASTM specifications for ferrous pipe, tubes, castings, fittings and bolting materials. There is a wealth of information in these specifications for engineers employed in the design, manufacture or testing of steel piping materials.

Recent standards

Publications listed below are available at a nominal price from The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

Cast-brass solder-joint drainage fittings. *ASA B16.23-1955.*

Preferred limits and fits for cylindrical parts. *ASA B4.1-1955.*

Graphical symbols for plumbing. *ASA Y32.4-1955.*

Butt-welding ends. *ASA B16.25-1955.*

Slotted and recessed head tapping screws and metallic drive screws. *ASA B18.6.4.*

System for straight bevel gears. *AGMA 208.01, ASA B6.13-1955.*

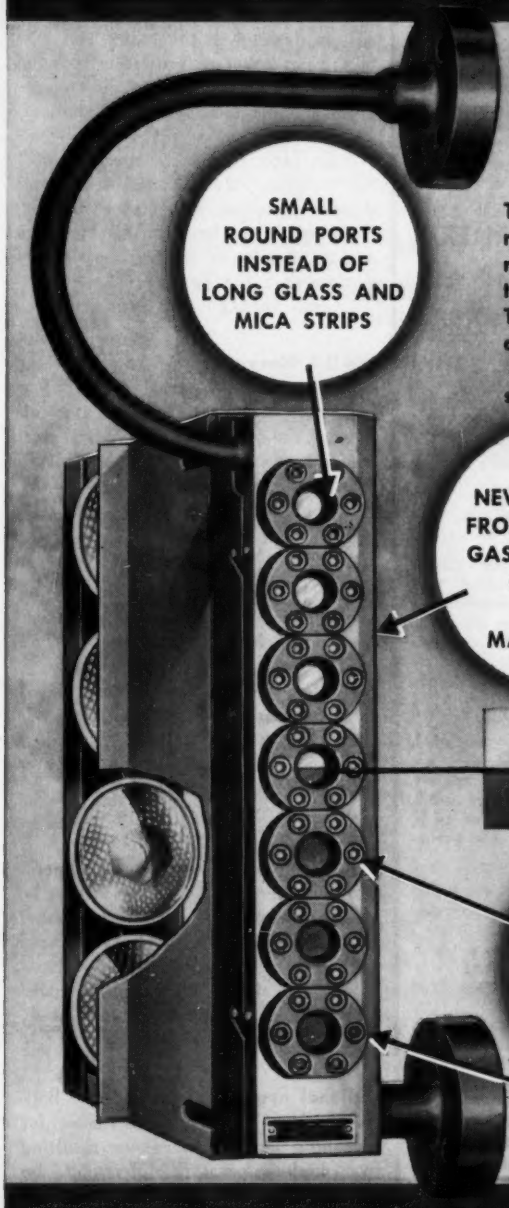
Small solid rivets. *ASA B18.1-1955.*

"Just tell him you know what a slice bar is and your as good as hired."

MAKING Great Savings in GAUGE MAINTENANCE

(BOTH TIME AND COST)

DIAMOND "Multi-Port" BI-COLOR GAUGE


SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS
GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE
STEAM SHOWS RED
WATER SHOWS GREEN
COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES
EACH PORT THERMALLY INDEPENDENT
7320

The Diamond "Multi-Port" Bi-Color Gauge makes startling reductions in maintenance costs. In cases where accurate records have been kept, labor and material costs are less than 1/5 the maintenance of conventional open port gauges. This is due to the unique design . . . note particularly the advantages that are pointed out on the photograph.

The "Multi-Port" operates on the Bi-Color principle . . . steam always shows red . . . water always shows green. There can be no question of water level. The gauge has been in continuous successful high pressure operation for more than three years in leading central station plants. Users report excellent readability and exceptionally high availability as well as important reductions in maintenance. Return the coupon below to get a copy of Bulletin 1174U.

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Please send me without obligation a copy of new Bulletin No. 1174U explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

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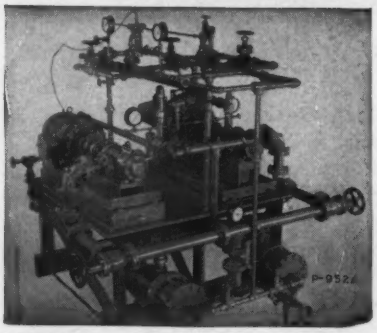
FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

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COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

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WIDE VIEW PEEPHOLE

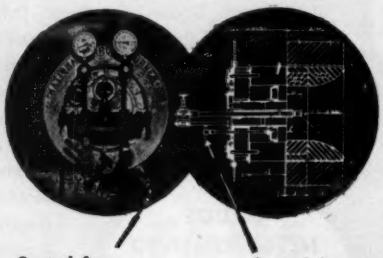
IGNITION PORT

FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER

These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

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LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More ARGUMENTS

Begins on page 140

Use hot water

I see no danger of boiler damage from 235-F water. At one plant where I was engineer six years, we regularly filled three 17,500-lb-per-hr 125-psi boilers with water from the feed heater at 220 F. These were Type-H Stirling boilers with drum thickness of ¾ in.

Water was throttled to prevent excessive flashing in the boiler and also to prevent robbing feedwater from the boilers on the line. These units were given a hydrostatic test every summer, and no damage was ever noticed.

Take care, though, to avoid exceeding the capacity of the feed heater and thereby lowering temperature of the feedwater in the heater. This increases danger of oxygen and carbon dioxide getting past the heater.

GEORGE DIEGLE *Marion, Ohio*

The U.S. Navy says, "The hottest water available should be used for filling a boiler, the water preferably being run through the feed heater." *Chief Watertender Instruction Manual,* page 115.

GORDON JANZ *Milwaukee, Wis*

Watch your step

tubes. Extent of hammer depends on rate 235-F feedwater enters boiler. Also, after feedwater is shut off and flash steam condenses above water level, air enters boiler through vents. This must be driven off after fires are lit and boiler begins to steam.

We think Atwell is doing more harm than good to his boilers.

ART BELTON *Montreal, P. Q.*

Considering drum stress, the temperature of water to fill a boiler should be no more than 100 F above or below the drum temperature. To prevent localized heating or chilling that could cause tube-seat leakage, it would be advisable to hold this difference to 50 F.

JACK FISHER *N. Madison, Ind.*

Sectional header or straight-tube boilers do not have much provision for absorbing large expansions resulting from high-temperature differences. So temperature of filling water should be low to avoid high stress.

Bent-tube units can absorb greater expansion and may be filled with relatively high-temperature water.

Recommended procedure is to obtain maximum filling-water temperature suggested by the boiler manufacturer.

H B WAYNE *Brooklyn, N. Y.*

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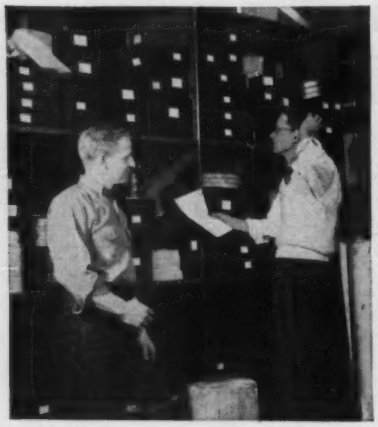

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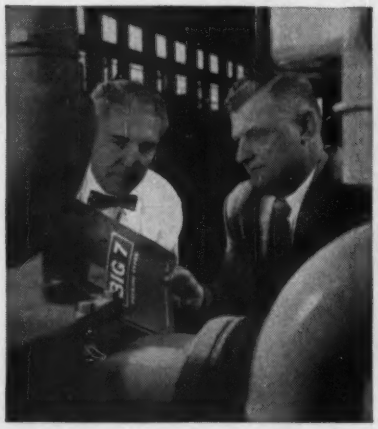

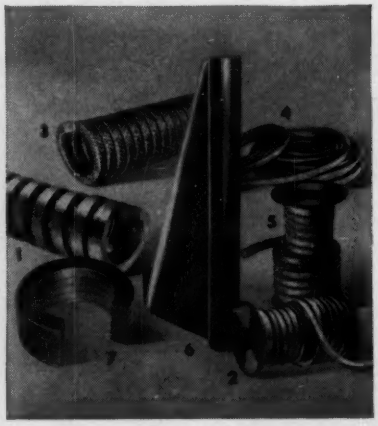

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COMPRESSORS

Continued from page 99

after receiving a direct spray of liquid refrigerant. A thermostatic expansion valve, or some other type of metering device, controls amount of refrigerant fed. Valve is set to maintain a predetermined gas-outlet temperature. This is usually 10 to 15 F above the temperature corresponding to the intermediate pressure. Feeler bulb of the expansion valve is clamped onto the outlet pipe, thus controlling the amount of refrigerant entering the intercooler. Direct-expansion intercooling is more common with ammonia than Freon or Genetron because with it, discharge temperature of gas is higher.

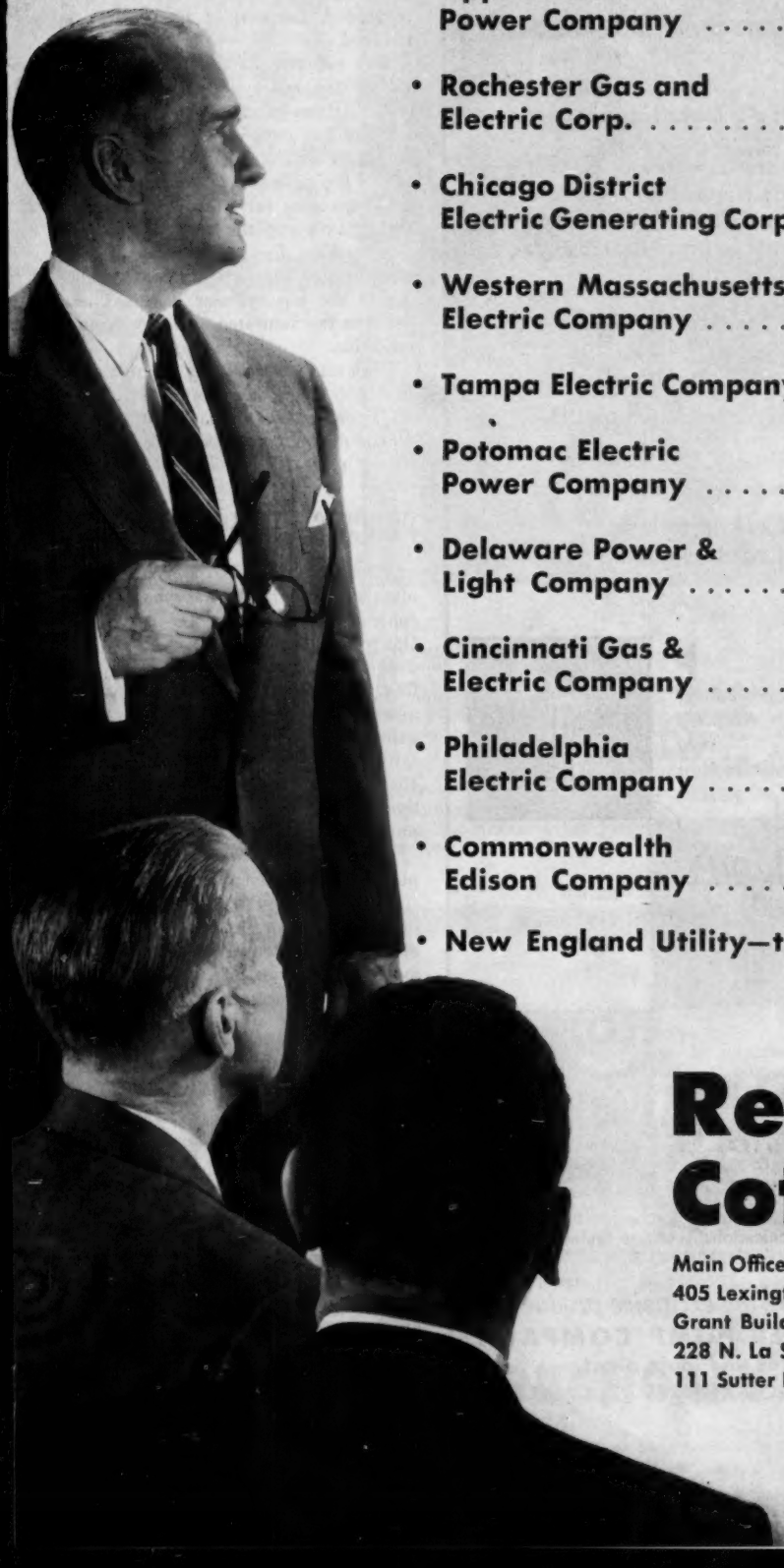
Combined intercooling, Fig. 3, uses both water and direct expansion. Arranged for series flow of the gas, the method shown would be used only where a large quantity of low-temperature cooling water is available.

Flash cooling of the liquid with direct-expansion intercooling, Fig. 4, reduces the horsepower per ton of refrigeration over single-stage compression, when correctly applied. But not all 2-stage systems can use liquid subcooling because of the economic factors. A plant having its evaporator at a great distance from the compressor would not be a good candidate for liquid subcooling because the line between the subcooler and evaporator must be carefully insulated. Power savings cannot compensate for the extra insulation cost if it is excessively high. In some small plants the savings do not warrant the extra cost of the subcooler.

Hookup in Fig. 4 gives the lowest liquid temperature, cooling the refrigerant liquid to a temperature corresponding to the intermediate pressure. A disadvantage of this subcooling type is that the liquid pressure is reduced from that at the condenser to the intermediate level. Little or no pressure may be available at the inlet of the evaporator expansion valve. This can occur when the distance between subcooler and evaporator is great. A large liquid line and refrigerant valve must be used when the pressure available is only 10 or 15 psi.

Fig. 5 shows a coil-type liquid subcooler combined with direct expansion. Main liquid feed from the condenser runs through the coil. Some liquid is taken from this line and fed to the cooler shell to evaporate at the intermediate pressure and subcool the liquid. Liquid is cooled to about 8 to 10 F above the temperature corresponding to the interstage pressure. Small liquid lines and valves can be used.

Fig. 6 shows a combination direct-expansion intercooler and coil-type sub-



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• Potomac Electric Power Company	Potomac River	5
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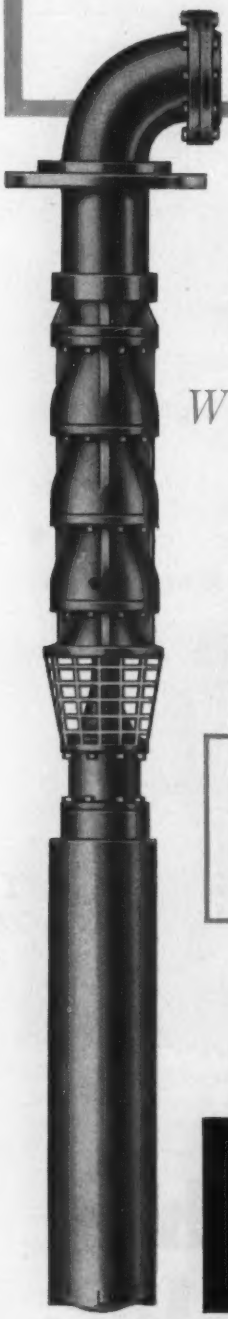

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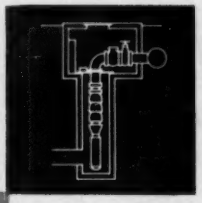
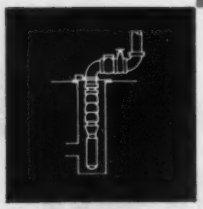
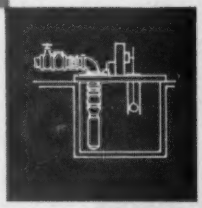


fire protection

sump operation



cooling tower service



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COMPRESSORS

Continued from page 192

cooler. Arrangement in Fig. 6 is the same as in Fig. 5 except that gas and liquid subcooling are performed in one shell. Interstage piping is cheaper with this shell type when two compressors are used to make a multistage system. Since only one shell or vessel is needed, the cost of intercooling is reduced.

Gas volume. In computing the gas volume the h-p cylinder is to handle, note that the gas temperature for Fig. 1, 2 and 3 is given above. For the units in Fig. 4 and 5, the gas temperature to the h-p cylinder must be computed. The expansion valve on the intercooler maintains a superheat of 10 to 15 F. Gas flashing for liquid subcooling is at saturation temperature. So gas flowing to the h-p cylinder is somewhere between the saturated and superheated condition.

High-stage suction-gas temperature in Fig. 6 is the same as in Fig. 2 and 3. In all gas calculations the heat gained during transmission through the piping must be considered.

PROCESS WATER

Continued from page 102

often contain a high free carbon-dioxide content, making aeration necessary. One ppm of dissolved oxygen will be used up in oxidizing 7 ppm of ferrous iron expressed as Fe (the amount required for oxidizing manganous manganese is practically the same). Water, saturated with air at 60 F, contains 10 ppm of dissolved oxygen, which theoretically is sufficient to oxidize 70 ppm of ferrous iron.

The oxidation, however, does not take place at a sufficient rate until neutralization is effected and the pH brought up to or preferably somewhat above 7.0 for iron and 9.0 to 10.0 for manganese. Neutralization may be effected with lime, soda ash or caustic soda. As in the removal of ferrous bicarbonate, the equipment used is much the same—aerator, settling basin and filters—except that a chemical feeder is always required. This is not always necessary in removing ferrous bicarbonate.

Cold lime soda. Acid waters containing ferrous sulfate or manganous sulfate, or both, may have these metals removed simultaneously with reduction of the hardness to whatever is required down to about 4 gpg (68 ppm) by the cold-lime-soda process. Equipment consists of an aerator, water softener and filters. The sludge-blanket-type softener is widely used for this purpose and the aerator is usually

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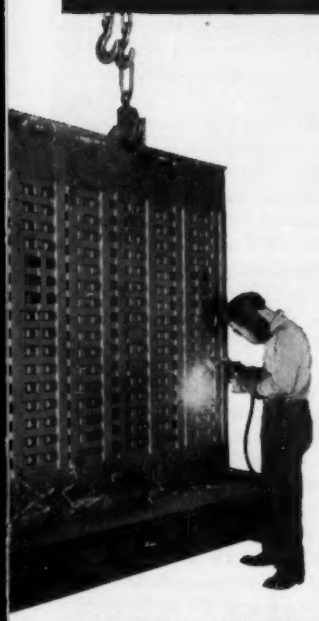

. . . 534 Easier Welds

This printing press bedplate manufactured by Graver Tank & Manufacturing Co., Inc., must be welded in 534 places. High alloy steel with the needed strength was very difficult to weld. But USS "T-1" Steel is easy to weld . . . and has the needed strength to keep these bedplates, used on high-speed printing presses, as lightweight as possible.

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International Nickel Company of Canada expects USS "T-1" Steel to increase the service life, to reduce the maintenance, and lower the long-term cost of ore cars like this one; because "T-1" Steel has far greater strength, toughness, and resistance to abrasion than steel used previously. The car builder, Canadian Car and Foundry Co., Ltd., has had no difficulty fabricating this very strong alloy steel.

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PROCESS WATER

Continued from page 194

mounted above it. Because of the high pH values in the softener, a rapid oxidation is secured not only with iron but also with manganese.

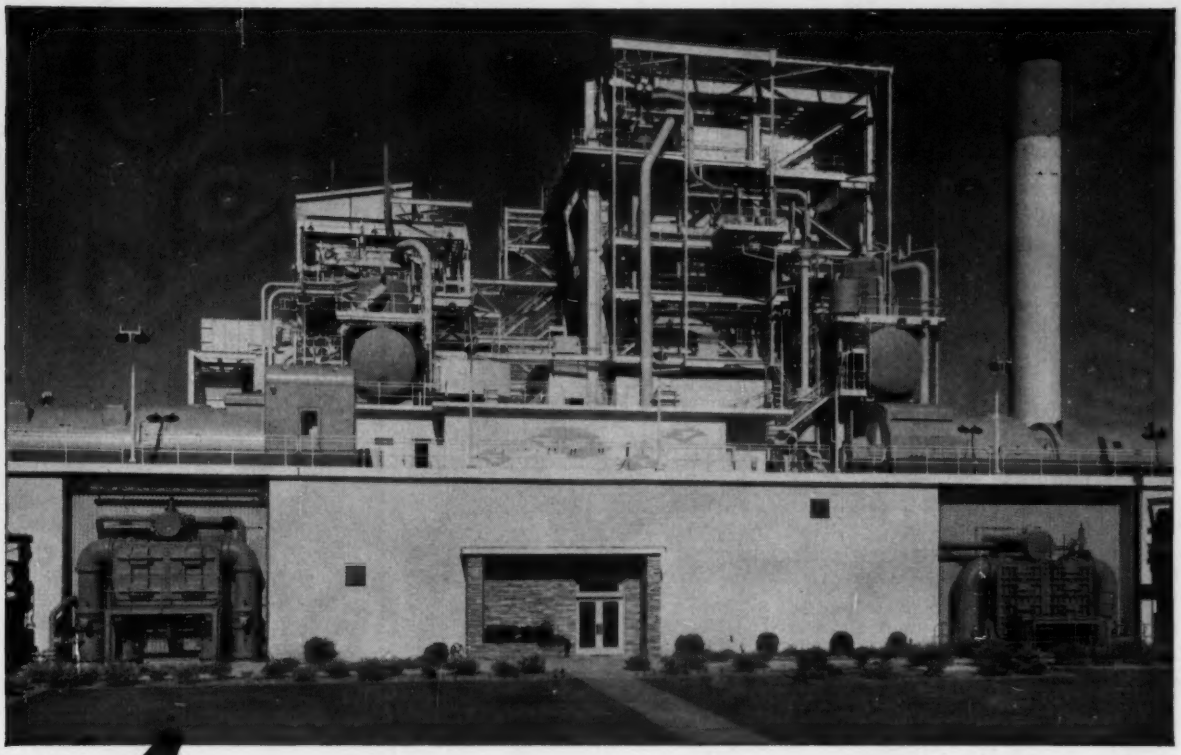
If the process water also requires softening to practically zero hardness, then the combination lime-zeolite water-softening process may be used. With this process on acid waters, little more is required than neutralization to a high enough pH value to effect a rapid oxidation of the iron or manganese. Most of the softening is then effected in the zeolite water softener.

High-color waters. In high-color iron- or manganese-bearing waters, part or all the iron or manganese may be present in an organic (chelated) form. Metals present in this form are not removed or only partly removed by any of the processes previously described. Aeration, settling and filtration, even at high pH values, usually accomplish no more than a partial removal—often not even that. Chlorination frequently has but little effect. Zeolite (sodium-cation exchanger) water softeners will not remove chelated iron or manganese.

Such waters, however, respond to coagulation, settling and filtration, which removes both iron and manganese and the great bulk of color. The coagulant which is most commonly used is aluminum sulfate (also known as filter alum). Dosages and optimum pH values vary with different waters or, at different periods, with the same water and are, therefore, best determined by a series of jar tests in the field on freshly drawn samples. In general, coagulant dosages may range from less than 1 to more than 5 gpg (17 to 85 ppm); pH values usually range from 5.5 to 6.8 with an occasional one below 5.5. A coagulant aid such as clay or activated silica may also be required especially with clear, high-color waters, which are low in dissolved mineral contents and practically free from turbidity. Whatever the type of equipment, it is almost invariably followed by filters to furnish a clear, low-color effluent, free of iron or manganese, or both.

Red waters. As the color is due to suspended, insoluble ferric hydroxide, filtration removes it easily. If very finely divided, a little aluminum-sulfate coagulant may be required. Usually the total amount of ferric hydroxide per day is rather small, settling is not required and pressure filters may be used.

If the ferric hydroxide is due to a corrosive water then the corrosive qualities should be corrected or the water,



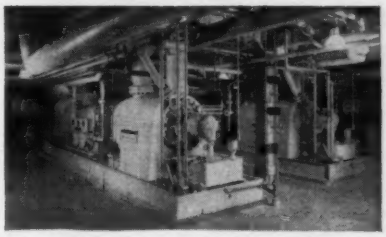
Again KYRENE STEAM PLANT

saves under-turbine space with I-R rectangular condensers

When Unit No. 1 of Salt River Power District's Kyrene Steam Plant went on line in June 1952, its 30/33,000 kw turbine-generator was served by a space-saving 27,500 sq. ft. I-R rectangular condenser, with I-R circulating and condensate pumps.

Now the same economy of under-turbine space has been extended to the newly completed Unit No. 2. Here, at right in photo above, the 60/66,000 kw turbine-generator is served by a 47,500 sq. ft. I-R rectangular condenser—again with I-R circulating and condensate pumps.

Designed and built by the Bechtel Corporation, the Kyrene plant located near Phoenix, Arizona represents the last word in modern, outdoor-type design. To assure maximum continuity of service, all major equipment was selected on the basis of long-range *dependability* in continuous, heavy-duty service. That's one of the vital but unseen features that's built into every item of Ingersoll-Rand steam plant equipment. Ask your I-R representative for complete details on the equipment best suited to your needs.



I-R BOILER-FEED PUMPS serve new generating unit, too

The 642,000 lb. per hr., 1500 psi steam generator for Unit No. 2 is served by the two Ingersoll-Rand high pressure, double-case boiler-feed pumps shown above—each rated 1,560 gpm, 4100 ft. head. Pump speed is flexibly controlled by an automatic fluid drive coupling.

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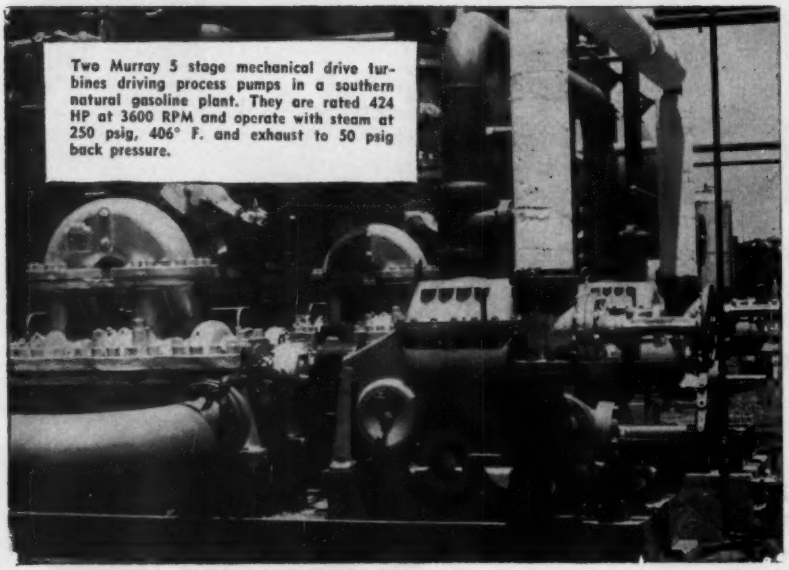

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Single governor valve with or without hand valves
Multiple automatic governor controlled inlet valves

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

PROCESS WATER

Continued from page 196

after filtration, is still corrosive. For process waters, the most widely used treatment is silicate of soda (ordinary water glass) and caustic soda. The usual amounts per 1000 gallons are 0.1 lb of 40-Be silicate of soda, plus enough caustic soda to just show a phenolphthalein alkalinity in the treated water. This means a pH value of about 8.3. This treatment should not be applied to boiler feedwaters, so if feedwater is from the same supply, it should be taken off ahead of the silicate feeder. Various types of chemical feeders may feed the silicate and caustic mixture, but probably the unit most widely used is the pressure-solution type.

Since the oxygen of dissolved air in the water is the primary cause of the corrosion, air removal, plus raising of the pH value, is effective in combating corrosion. So vacuum deaerators are useful, especially for long pipelines. If the water also has a low pH because of a high free carbon-dioxide content, the vacuum deaerator may also lower this sufficiently to raise the pH to the desired point. Otherwise, a small dosage of alkali or caustic and silicate mixture may be used.

For those process waters where hard ness merely has to be reduced to 4 to 5 gpg, the cold-lime or lime-soda process can be adjusted so the effluent forms a thin protective calcium carbonate scale on the metal. A similar scale could be produced from a water having some 3 or more grains of calcium hardness by feeding an adjusted dosage of alkali directly to the water.

Another method of reducing corrosion, whcih is sometimes used where the amounts of water required are relatively small, is to filter the water through a neutralizing filter. This device resembles the familiar pressure-type sand filter, except that the medium is calcite instead of sand. When waters with pH values below 7.0 are filtered through this relatively insoluble material (solubility in pure water is less than 1 gpg), enough dissolves to neutralize the water and automatically bring its pH up to 7.2 to 7.3. When completely softened water is required, the neutralizing filter should be installed ahead of the zeolite softener.

If the red water is due to some degree of aeration from air-lift pumps, pneumatic storage or open tanks, basins or elevated storage tanks, then besides filtration (or settling and filtration), aeration should be included. This is because there is no certainty that all the iron has been completely oxidized and precipitated. Nor is a single test sufficient to determine this for, with

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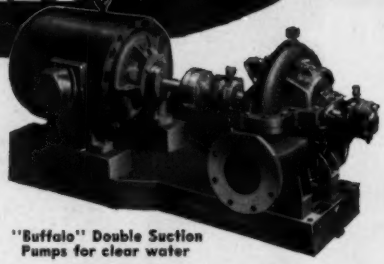

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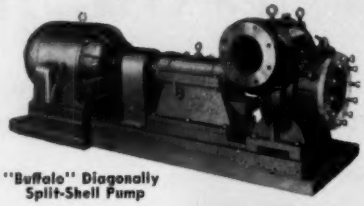
"Buffalo" Close-Coupled Clear Water Pump

CHEMICAL LIQUIDS

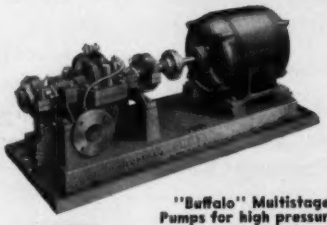
Husky "Buffalo" Single Suction Chemical Pumps are available for almost any chemical liquid a pump can handle—from acetic acid to zinc sulphate. These are built in a wide choice of trim, as well as rubber-lined for highly corrosive chemicals.



"Buffalo" Diagonally Split-Shell Pump

PAPER STOCKS

"Buffalo" builds efficient, long-lived pumps for every job in the mill. These range from Diagonally Split-Shell Pumps for high consistency stocks to rubber-lined models to solid shell pumps for agitation, etc. All are described in Bulletin 953.



"Buffalo" Multistage Pumps for high pressures

IN EVERY "BUFFALO" PUMP, you get a "plus" value—the "Q" Factor—the built-in Quality that means trouble-free satisfaction and long life. 79 years of hydraulic experience back up your choice of "Buffalo" as a top pump value.

"Buffalo" Chemical Service Pump

"Buffalo" PUMPS

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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

PROCESS WATER

Continued from page 198

tanks the water at various times, even in a single day, may be (1) free of iron (2) turbid with suspended ferric hydroxide but free from soluble ferrous bicarbonate (3) clear but containing all the soluble ferrous bicarbonate, or containing both insoluble ferric hydroxide and soluble ferrous bicarbonate.

Iron pickup. In a condition that sometimes occurs, a water free of dissolved oxygen is pumped through old, rusted, tuberculated pipe. Then some of the iron deposits are reduced to the ferrous state and go into solution as ferrous bicarbonates. This iron can be removed by any of the processes mentioned for the removal of iron as ferrous bicarbonate. Iron pickup can be stopped by adding some air to the water so the outer surfaces of the tubercles are always in the insoluble ferric condition. Then, if the water is too corrosive, it can be treated to reduce its corrosive properties.

WATER TREATMENT

Continued from page 89

and sludge. It usually takes several days to build up a good sludge blanket with stable characteristics. This depends, of course, on the amount of hardness removed and water quantities treated.

During initial startup save time and chemicals by trying out various proportions, particularly of coagulant, on water samples that are agitated and then allowed to settle.

Before filling the softener, check it carefully for (1) leaks (2) cleanliness (3) proper position and secure fastening of distributing, draw off and sampling pipes (4) proper arrangement, alignment and condition of all moving mechanical parts.

It is usually a big job to de-water and clean out a softener. Make every possible part right and tight before starting the unit. Try out, adjust and lubricate chemical pumps, feeders and controls. See that there is an adequate supply of chemicals on hand a few days before starting.

Train operators to run necessary tests. Outline preliminary procedures for operating the softeners.

Cold-process batch-type softeners do not usually bring hardness down below 20 to 30 ppm. Sludge- or slurry-type cold units work down to 10 to 15 ppm, and use somewhat fewer chemicals while doing it.

Hot process lime-soda softeners carry reactions down to 1 or 2 ppm hardness and often incorporate a de-

Announcing

TWO GREAT EVENTS FOR MAY 17TH

THE CONSOLIDATION OF THREE GREAT COMPANIES

The Key Company, W-K-M Manufacturing Company, Inc., and acf Valve Division — all members of the acf Industrial Family — have been brought together as W-K-M Manufacturing Company, a subsidiary of acf Industries, Inc.

Management, Manufacturing and Marketing facilities of all three are now centralized in this new 12-acre completely air-conditioned office and plant at Missouri City, Texas, a few miles west of Houston.

This consolidation provides important efficiencies of production of W-K-M Through-Conduit Valves, acf Lubricated Plug Valves, Key Return Bends, and Key-Kast Welding Fittings. These products, with a long established reputation for excellent service and performance, will continue to be engineered, manufactured and sold by the same experienced personnel who were instrumental in building that reputation.

OPENING OF A GREAT NEW PLANT THURSDAY, MAY 17TH TWO to SEVEN P. M.

You are cordially invited to inspect our new Plant and Office at Missouri City, Texas, just a few miles west of Houston.

Special transportation from downtown Houston to the plant will be provided for visitors. Please write immediately for your Transportation Pass. Address W-K-M Manufacturing Company, Guest Committee, P. O. Box 2117, Houston, Texas.

W-K-M MANUFACTURING COMPANY, INC.

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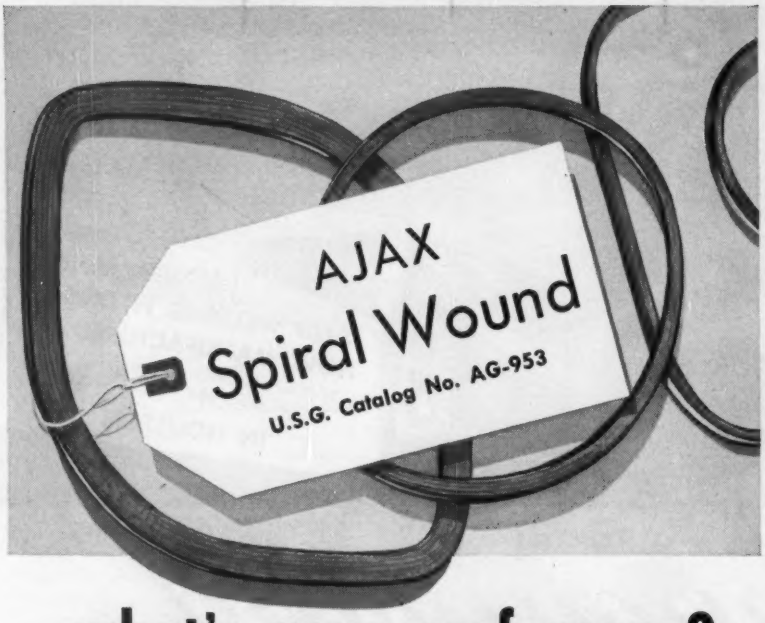
W-K-M THROUGH-CONDUIT GATE VALVES

acf LUBRICATED PLUG VALVES

KEY RETURN BENDS AND FITTINGS

Boiler Gaskets . . .



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Yes, the U. S. Gasket—Belmont Packing line of Boiler Gaskets includes *both* popular types—spiral wound metal-asbestos and wire-inserted woven asbestos—for manholes, handholes and tube caps of all makes of stationary and marine boilers, waterwalls, economizers and other boiler accessories.

So, whatever your preference and operating pressure requirements, ask your U. S. Gasket—Belmont Packing distributor—or write for literature.

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U.S. GASKET • BELMONT PACKING

WATER TREATMENT

Continued from page 200

aerating and silica-removing effect as well. The resulting effluent, after passage through a filter, is quite satisfactory for boiler-water makeup, even where makeup percentage is high. Because hot water tends to pick up silica in a sand filter, anthracite filters are usually used with hot-process softening.

If the operation requires an even better removal of hardness, using some form of phosphate with hot-process softening gives practically zero hardness in the effluent. The reaction comes to best completion at pH of about 9.7 and with 5 or 10 ppm excess phosphate ion present. Depending on the alkalinity and type of water treated, various compounds of the phosphate group, from the most alkaline trisodium phosphate to the most acid, phosphoric acid, may be used. But cost of phosphate chemicals is high. So this process is mostly used where initial hardness is not over 50 ppm, or where preliminary cold-process lime-soda softening has been used.

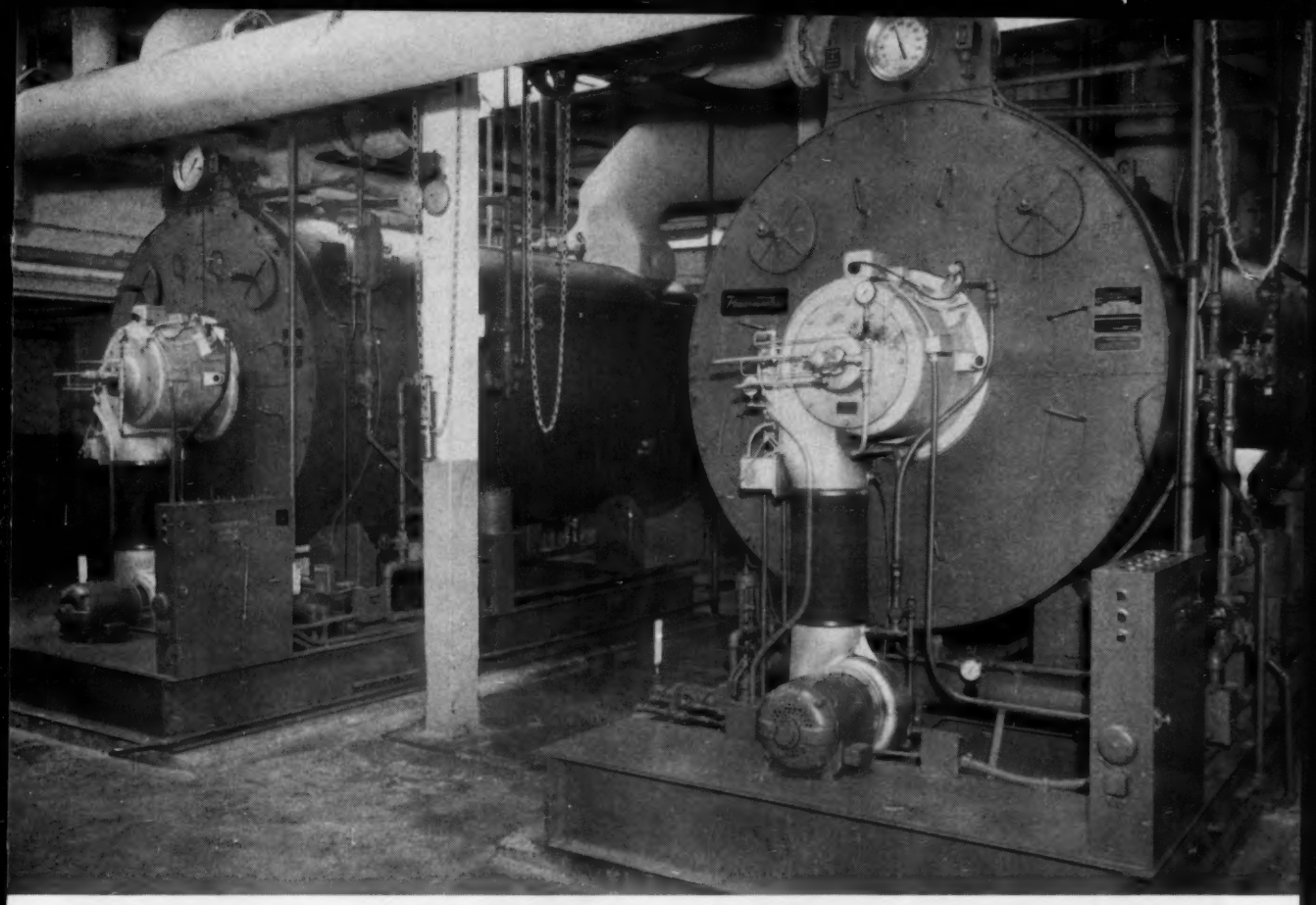
With phosphate treatment especially, and to some degree with lime-soda softening, the effluent is supersaturated. It may tend to form scale in pipe lines, preheaters or economizers where there is a large temperature rise. This often requires treatment with a small amount of acid or carbon dioxide to stabilize the water, or use of special organic scale inhibiters.

Another softening method uses zeolite material. This may be either sodium or hydrogen zeolite or a combination of both.

Sodium zeolite exchanges its sodium ions for calcium or magnesium ions in the water. Thus sodium compounds of a non-scale-forming nature are produced in the water being treated. The material becomes exhausted after removing a certain amount of hardness. It is then regenerated by washing with a strong sodium-chloride solution. This replaces the calcium and magnesium ions with sodium ions. After the brine and the calcium and magnesium chloride resulting from the reaction have been rinsed out of the zeolite material, softener is ready to go back to work again.

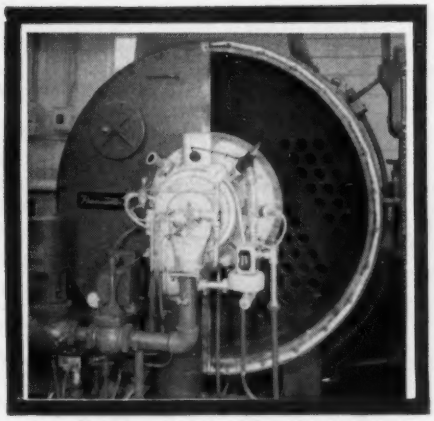
A sodium-zeolite softener gives water of "zero" hardness if it is not exhausted too far. It is simple to operate and can be made in very small sizes. On the other hand, it does not reduce total solids or total alkalinity.

This tends to make the water quite alkaline when concentrated in a boiler. Unless it is promptly deaerated, the water may be corrosive as there are no



WHY TWO?

Powermaster® PACKAGED AUTOMATIC BOILERS



Time-saving inspection and cleaning of *Powermaster* is provided by easy removal of sectioned front cover without disturbing burner, accessory equipment or piping; by convenient handholes; and by easily removable rear cover. This simple and complete accessibility is a big advantage in maintaining clean, efficient operation over the entire life of *Powermaster* units.

● Major operating advantages are gained by installing two or more *Powermasters* rather than a single large boiler. These include greater assurance of a constant steam supply, increased flexibility of operation, more efficient light load standby, reserve capacity for extra-heavy load demands and for rapid expansion, greater freedom from downtime for inspection and maintenance.

Sizable cost economies also are effected because of *Powermaster's* simplified installation, space-saving compactness, automatic time-saving operation, fast steaming and quick response to load swings, high fuel economy at all loads, maintenance-saving accessibility and other service-proved features.

These are reasons why multiple *Powermaster* installations are now serving numerous manufacturing industries, institutions, public buildings, schools, housing projects, laundries, military posts and other steam users.

Be sure you take a close look at *Powermaster* advantages whenever you're looking for a dependable, low-cost steam supply for any plant or building requirement. Ask for Bulletin 1220.

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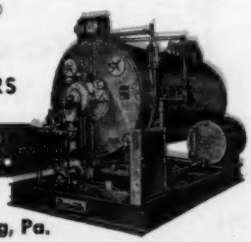

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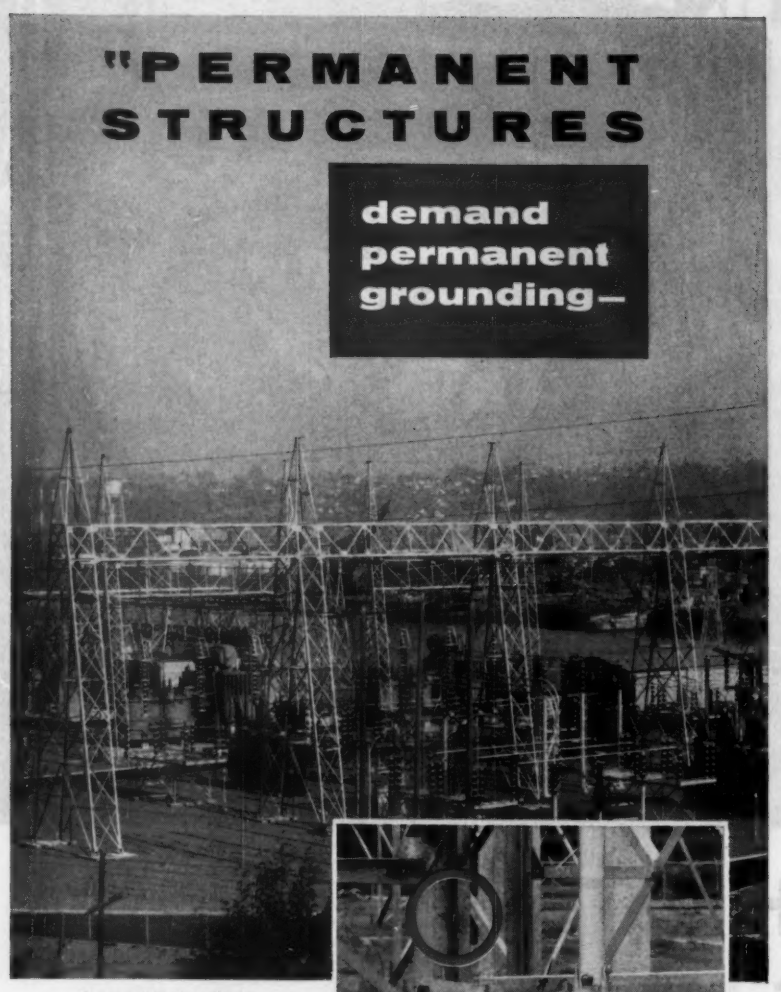

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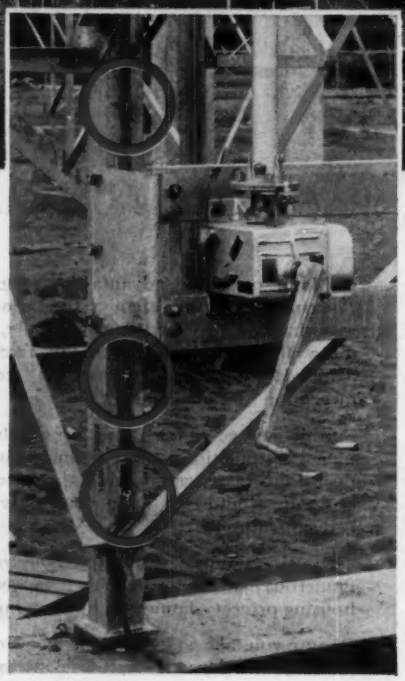

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WATER TREATMENT

Continued from page 202

calcium compounds present to form a protective scale.

A number of different zeolite materials, both natural and synthetic, are available to meet different requirements. The pH of the incoming water should generally be between 7.0 and 8.3. Temperature should not exceed 100 to 140 F.

Check the manufacturer to see that the material furnished is suited to the conditions. No silica will be removed in the sodium-zeolite softener and with certain zeolites, silica may actually be picked up.

Hydrogen-zeolite softeners are somewhat similar to sodium-zeolite units. But the hydrogen unit absorbs sodium as well as calcium and magnesium ions, thus forming acids in the water and calcium or magnesium zeolite compounds. When the bed becomes exhausted it is washed with acid, generally sulfuric acid, and is thus regenerated. The excess acid and the calcium or magnesium sulfate formed in the regeneration is then washed out of the bed and softener is ready for use again.

Carbonic acid, H_2CO_3, is formed in the hydrogen-zeolite softener by the temporary hardness in the water. This acid is unstable. It is readily removed by either aeration or degasification, thus permitting some reduction in the total solids.

The effluent is ordinarily too acid to use and must be neutralized by an alkali or alkaline water.

If a sodium and a hydrogen-zeolite softener are operated in parallel, the ratios of the two waters may be adjusted to blend and give the desired pH or alkalinity. This is the method most often used in large plants.

If the raw water is quite alkaline and a small amount of hardness is not too objectionable, raw water and hydrogen-zeolite effluent may be blended. This gives a fairly satisfactory product and eliminates the need for a sodium softener.

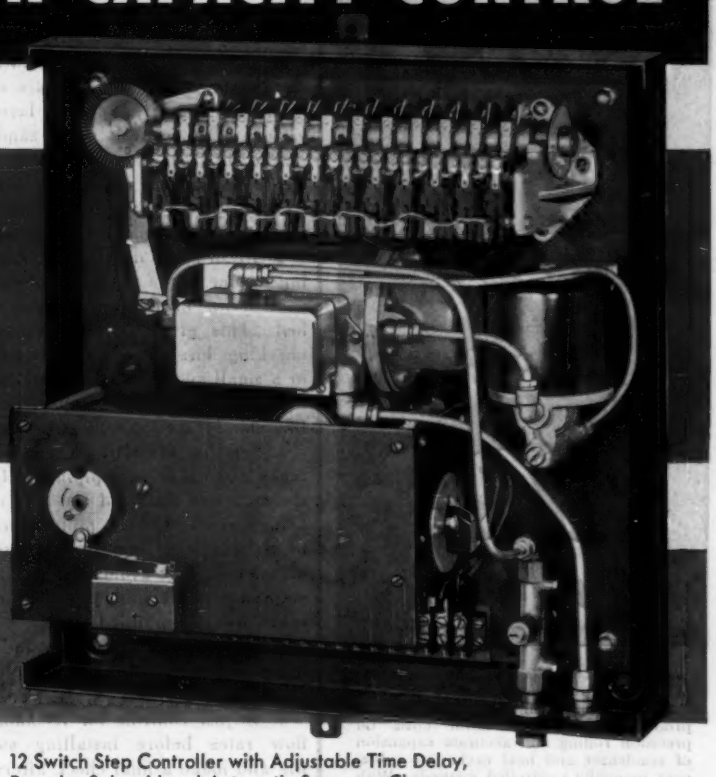
A third method often used for small installations is to add an alkali like caustic soda, NaOH, or soda ash, Na_2CO_3, to neutralize the acidity in the water. Aeration of the hydrogen-zeolite effluent before blending assures a minimum residual of CO_2 in the water, and thus requires less alkaline material.

Before service. To put zeolite equipment into use:

1. Check tanks and piping to see that they are clean, level, properly installed and connected.
2. Check collecting header or head-

REFRIGERATION CAPACITY CONTROL

JOHNSON Pneumatic Step Controller



- BALANCES CAPACITY WITH LOAD
- PREVENTS SHORT CYCLING
- EQUALIZES WEAR OF EQUIPMENT

12 Switch Step Controller with Adjustable Time Delay, Recycler Solenoid and Automatic Sequence Changer.

What It Does

This new and improved controller is designed to accomplish, with a single compact unit, everything that is desired for the control of multiple step refrigeration installations, including "on" and "off" operation of the steps in sequence, positive prevention of the starting of more than one compressor at a time after night shutdown or after current failure, and manual or automatic changing of compressor operating sequence to equalize wear. It can be used to control one or a group of refrigeration machines. It completely eliminates all the disadvantages of a series of separate pressure switches.

How It Works

The Johnson Pneumatic Step Controller, in response to changes in pressure from a controlling thermostat, actuates a number of separately adjustable, snap-acting, single-pole, double-throw switches in any desired sequence. Control arrangements include (1) starting and stopping two or more compressors in sequence, (2) operation of cylinder unloaders in sequence, or (3) a combination of (1) and (2).

Special Features

Recycler and Time Delay—Recycler Solenoid immediately returns all switches to their normal position on shutdown or current failure. Time Delay assures the proper interval between successive switch operations on start-up or when current is restored after failure.

Sequence Changer—Varies the starting sequence of compressors to equalize running time and wear. Step Controllers are furnished with either Manual or Automatic Sequence Changer.

Models—Choice of 4, 6, 8 and 12 switch units, with or without special features such as Recycler, Adjustable Time Delay and Sequence Changer.

* * *

Installation and operation of the Johnson Pneumatic Step Controller is both simple and inexpensive. A nearby Johnson engineer will gladly explain, without obligation, how it can best solve your special problems, or write today for full details.

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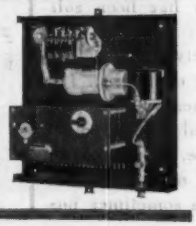
OTHER APPLICATIONS

Johnson Step Controllers are also used to control multiple fan or pump installations, electric heaters and other systems where electrically actuated devices are to be operated in sequence from a proportional acting pneumatic controller. Send the coupon for more facts.



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Please send me Apparatus Bulletin G-180 describing specifications, features and application of Johnson Pneumatic Step Controllers.

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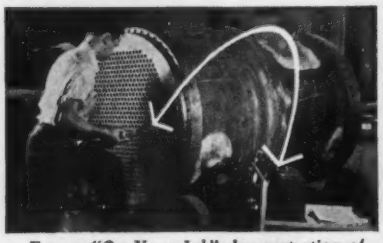

For an "On Your Job" demonstration of AIRETOOL'S Tube Expansion Control System, contact your nearest AIRETOOL representative, or write, wire or phone the AIRETOOL Mfg. Co., 318 S. Center St., Springfield, Ohio.

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European Plant:
Vlaardingen, The Netherlands.

WATER TREATMENT

Continued from page 204

ers in the bottom of the softener shell. The nozzles should be level and clear.

3. See that manufacturer's instructions on proper gravel, sand and zeolite layer depths and sequence are closely followed. Usually several layers of various-sized gravel and sand are placed first, then zeolite material is added in layers of several different sizes on top of the gravel. The larger sizes are placed near the bottom.

4. Record the depth from distributing header in the top space of the softener down to the top of the zeolite bed. This gives you a reference for checking loss of zeolite. Expect loss of a small amount of fine material during the first few days of operation. But this should not continue for long.

5. See that the acid or brine storage tanks and connecting piping will resist the corrosive action of the acid or salt being used. Check piping arrangements and valving before ordering chemicals. This avoids the problem of emptying tanks and piping after the tanks have been filled.

6. Arrange convenient and safe means for handling and unloading chemicals.

7. Adjust controls for recommended flow rates before installing softener fill, and make a final check afterwards. These controls limit rate of backwash, brine or acid feed and rinse; they are usually weirs and flow-controlling valves or orifices.

8. After a week or two of operation, inspect the zeolite bed to determine whether flow rates are causing unevenness or loss of material. Some means of feeding a specified amount of brine or acid is usually supplied; it should be adjusted to give required chemical feed for proper regeneration of exhausted zeolite.

9. Usually, go through two or three regeneration cycles before putting softener into operation.

Depending on water hardness, softening capacity and volume of zeolite material, you can soften a rather definite quantity of water between regenerations. Delaying regeneration after hardness begins to appear in effluent is likely to lower zeolite capacity. Check for hardness frequently, and use an alarm to indicate when usual safe quantity of water has been softened.

Softener capacity between regenerations can be altered by changes in (1) incoming water hardness (2) zeolite capacity (3) deposit of iron or other materials on the zeolite.

Treatment with acid or other chemicals for regeneration is sometimes pos-

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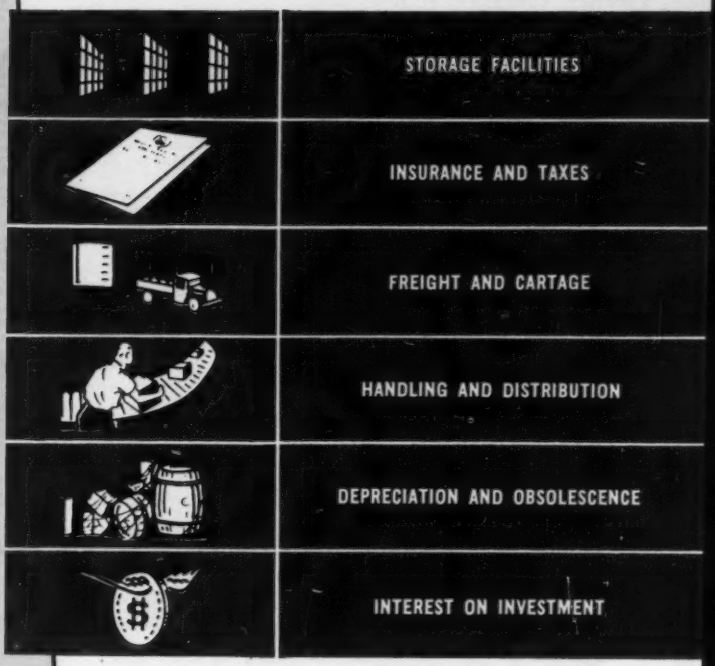

* Minimum cost determined from survey made by "Industrial Distribution."

Stock carrying costs are worth the careful consideration of every company in industry. The figures here are the findings of INDUSTRIAL DISTRIBUTION magazine from an analysis of plant cost studies. But this saving is only one of numerous advantages the industrial jobber offers you. Others are: time-saving in delivery, ordering convenience, technical assistance, etc.

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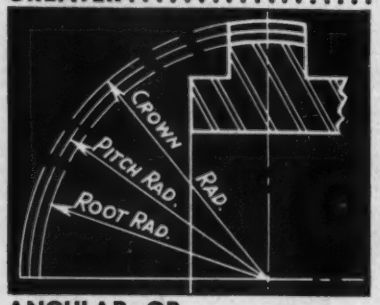

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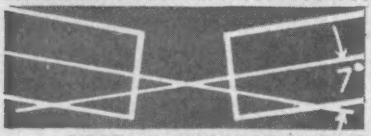

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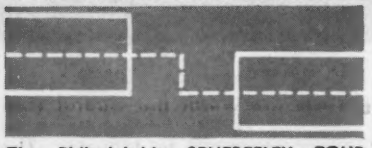
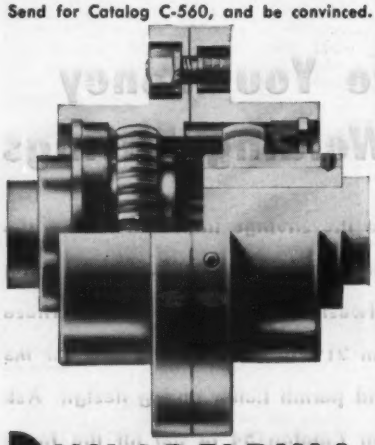


The Philadelphia SPHEREFLEX COUPLING features a Spherical cut tooth which allows a ball and socket action between mating teeth up to 14° angular misalignment—and due to this angular capacity, a much greater amount of parallel misalignment is possible, which varies directly as the pitch diameter of the gears. All this is accomplished by gearing having a minimum back-lash.

By using Sphereflex Couplings, you can eliminate excessive bearing loads and cyclical bending stresses, which are caused by misalignment between shafts.

Send for Catalog C-560, and be convinced.



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WATER TREATMENT

Continued from page 206

sible. Consult the manufacturer.

On most of the larger zeolite installations a multiport valve simplifies the manipulation required to backwash, regenerate and rinse. Install a check valve at softener outlet to prevent possible flow reversal, particularly if hot water might be forced through the multiport valve and into the unit. Both the hard-rubber valve and the zeolite material would probably be warped or damaged by hot water.

CATION-ANION EXCHANGE

Certain exchange materials remove the anions or negative ions from solution when the anions are in acid form, like sulfuric or hydrochloric acid.

In water-softening treatment, the cations or positive ions like calcium and magnesium may be removed with a cation exchanger operating on the hydrogen cycle (see above). The anions remain in solution as H_2SO_4, HCl, etc. If these solutions are then passed through the anion exchanger, the acidic salts are removed also. Dissolved solids are reduced so water purity approaches, but does not equal, distilled water.

Sodium hydroxide or sodium carbonate solution is used to regenerate the exchange material. Use distilled or softened water for rinsing. Otherwise, a floc or precipitate that will clog the bed may result from reaction of the calcium or magnesium in the rinse water with the carbonate or hydroxide remaining from the regenerating chemicals.

Neutral salts like sodium chloride and sodium sulfate are not removed effectively by this process, and silica is not removed at all. Hence this method may not prove a satisfactory alternate for evaporation if the water is to be used in boilers, particularly high-pressure boilers.

Tanks and fittings must withstand both the incoming acidic solutions and the alkaline regenerating and rinse solutions.

The reaction of the acidic solution with the alkaline exchange material forms carbonic acid. Remove this from the effluent by aeration. Although this raises the water's pH, the oxygen absorbed during aeration makes the water quite corrosive. There are few scale-producing elements left to plate out and protect metal surfaces.

Capacity of exchange materials for anion removal varies considerably, depending on (1) anion being removed (2) material size (3) strength of the incoming water. These materials are lighter than the usual zeolite materials; backwash rates must be proportionately lower to prevent loss. Re-

Save money on gauge maintenance. Always keep two gauge glasses "on the bench" for every one in use.

You save time when replacements become necessary, because:

Spare No. 1 is right at hand for immediate replacement during routine cleaning and maintenance of the gauge.

Spare No. 2 is ready for sudden emergencies. Provides quick replacement in case of breakage at night, for example, when your Industrial Distributor may not be open.

Play safe and smart on *all* your visual inspection problems. Call your Industrial Distributor, and order *extra* gauge glasses for all your vessels.

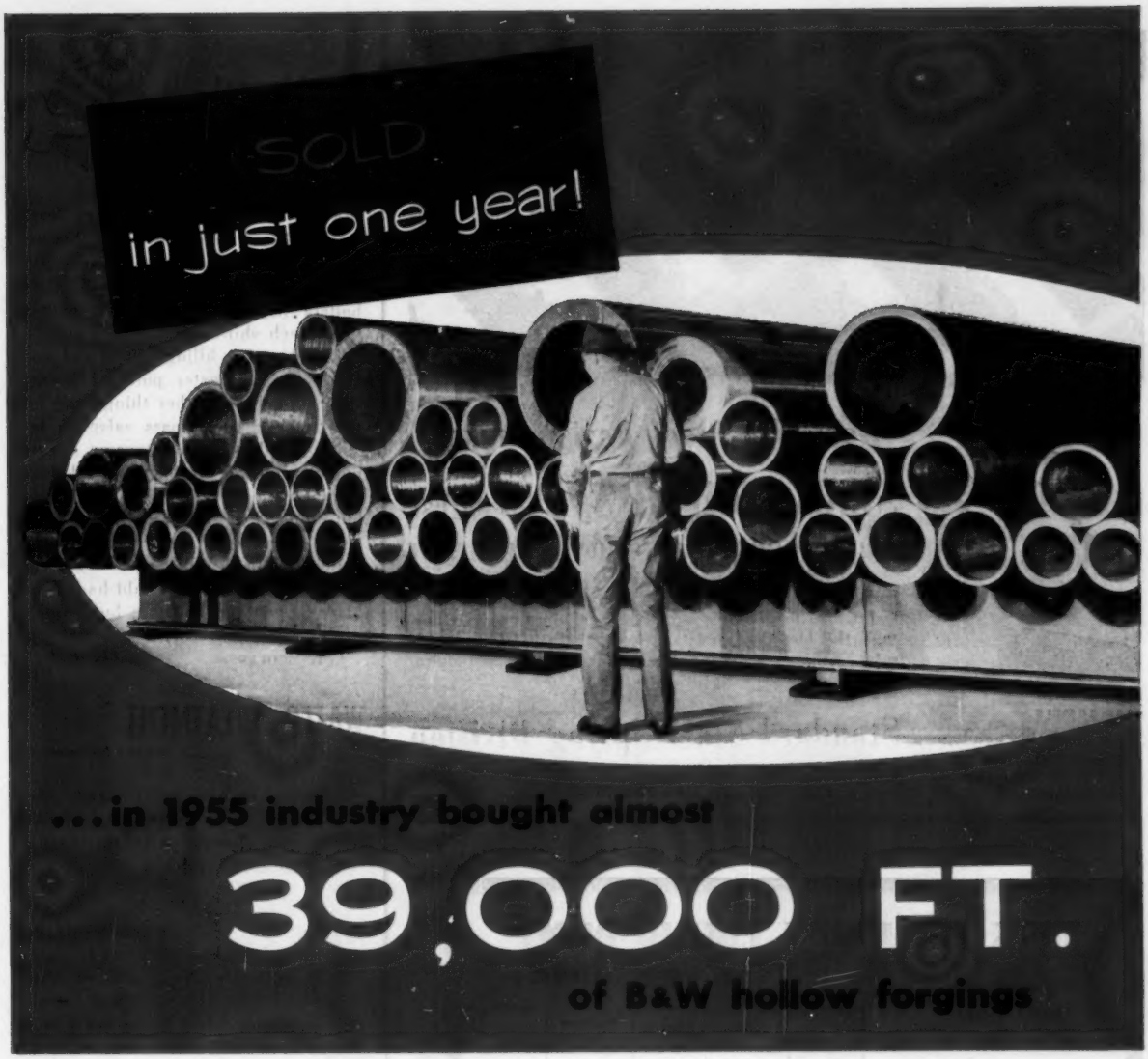
Remember: "ONE FOR THE GAUGE AND TWO FOR THE SHELF." And always specify hard-to-break CORNING®, PYREX® and MACBETH® gauge glasses. It's the economical way.

CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	Recommended Product
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Viewing inside furnaces, reactors pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass



This is an acceptance story that is more than seven miles in length! In one year, the power, petroleum and chemical industries placed orders for B&W Hollow Forgings in quantities measured by miles. The measure of their quality is based on two always-present facts:

1) B&W's unparalleled manufacturing facilities;
2) B&W's acceptance of small and large orders for definite delivery dates.

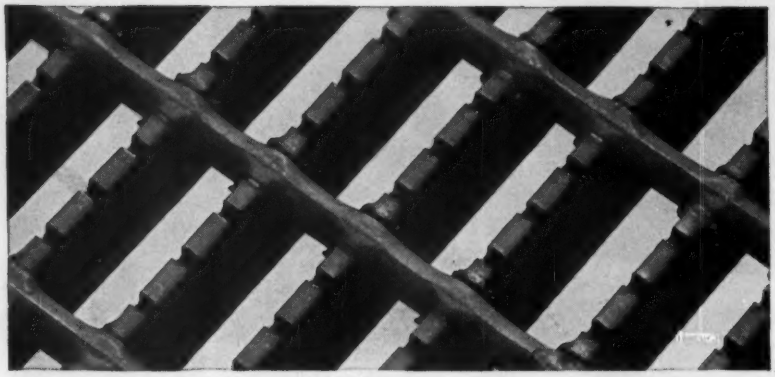
B&W Hollow Forgings are produced in a large range of fractional inch sizes and a selected range of standard pipe sizes in accordance with the following ASTM Specifications: A 106-52T seamless carbon-steel pipe for high-temperature service. Seamless drum forgings of A 266-54 carbon-steel. A 312-54T seamless and welded austenitic stainless steel pipe. A 335-53T seamless ferritic alloy steel pipe for high-temperature service. A 376-54T seamless austenitic steel pipe for high-temperature central-station service.

For the complete range of B&W Hollow Forgings plus other important information on what B&W has to offer you in Hollow Forgings, send for Bulletin S-16B. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

BABCOCK & WILCOX

BOILER DIVISION

5-455

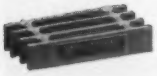


New Slip-Proof Design makes

Gary SERRATED GRATING safest

WHERE GOOD TRACTION IS IMPORTANT

Indoors or out, for area gratings in sidewalks, inclined walkways, fire escapes—wherever safe-footing is important, this one-piece, resistance-welded grating will provide safer working conditions. It's tailor-made to your requirements. Write for descriptive Catalog P-56.

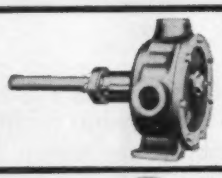
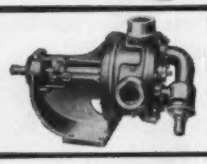
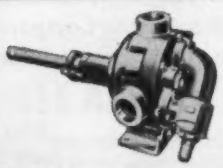


FREE SAMPLE
We'll send this handy paper weight if you request it on your company stationery.

Standard Steel Spring Division
ROCKWELL SPRING AND AXLE CO.
4018 East Seventh Avenue • Gary, Indiana

PICK THE RIGHT VIKING PUMP for your needs

it's easy with this Simple Chart

	Catalog	Service	Capacity	Maximum Pressure	Features
	Ask for Section Bw	General Purpose Pumps for Handling Liquids Ranging from Fuel Oil to Molasses	½ to 1050 G.P.M.	50 P.S.I. Non-Lubricating Liquids 100 P.S.I. Lubricating Liquids	Complete Range of Materials. Packed or Mechanical Seal. Jacketed Equipment.
	Ask for Section Cw	Heavy Duty Pumps Handle Both Thin and Very Viscous Liquids	10 to 300 G.P.M.	100 P.S.I. Non-Lubricating Liquids 200 P.S.I. Lubricating Liquids	Complete Range of Materials. Packed or Mechanical Seal Jacketed Equipment.
	Ask for Section Dw	Underwriters Pumps Handle All Types of Clean Hazardous Liquids	5 to 300 G.P.M.	50 P.S.I.	Standard Fitted Steel Fitted Bronze Fitted All Bronze Construction. Packed or Mechanical Seal.

Your Viking district office or distributor will promptly furnish complete information on these or many other Viking rotary pumps *to fit your needs.* Send for any of the above catalogs or check with your Viking distributor.

THE ORIGINAL "GEAR-WITHIN-A-GEAR" ROTARY PUMP

VIKING PUMP CO. Cedar Falls, Iowa

My biggest boner . . .

We use one unit only for peak loads. Remainder of time boilers for this unit are kept "on bank" with steam up to near operating pressure. We fill these boilers through a bypass valve once or twice each shift.

One day after filling boilers and shutting down feedwater pump, I became preoccupied with other things and forgot to close the bypass valve on last boiler filled. Next shift came on and put this unit on the line for peak load. Operator opened the regulator valve, but didn't check to see if bypass valves were closed. ONE WAS OPEN. This boiler filled with water and carried over into turbine. As luck would have it, no blades were knocked out, but damage could have been costly.

C K SCOLES *Pueblo, Colo.*

WATER TREATMENT

Continued from page 208

generation is usually required when effluent pH falls below 4.3, approximately the change point for methyl-orange indicator solution.

DISTILLATION

When water boils at reasonably low pressures, the steam produced is almost free from solids if droplets of water do not carry over along with the steam. This is accomplished by having a large releasing surface for the steam, or by scrubbing or washing out the entrained impurities. The condensed steam forms a pure distillate for boiler-water makeup or other process use.

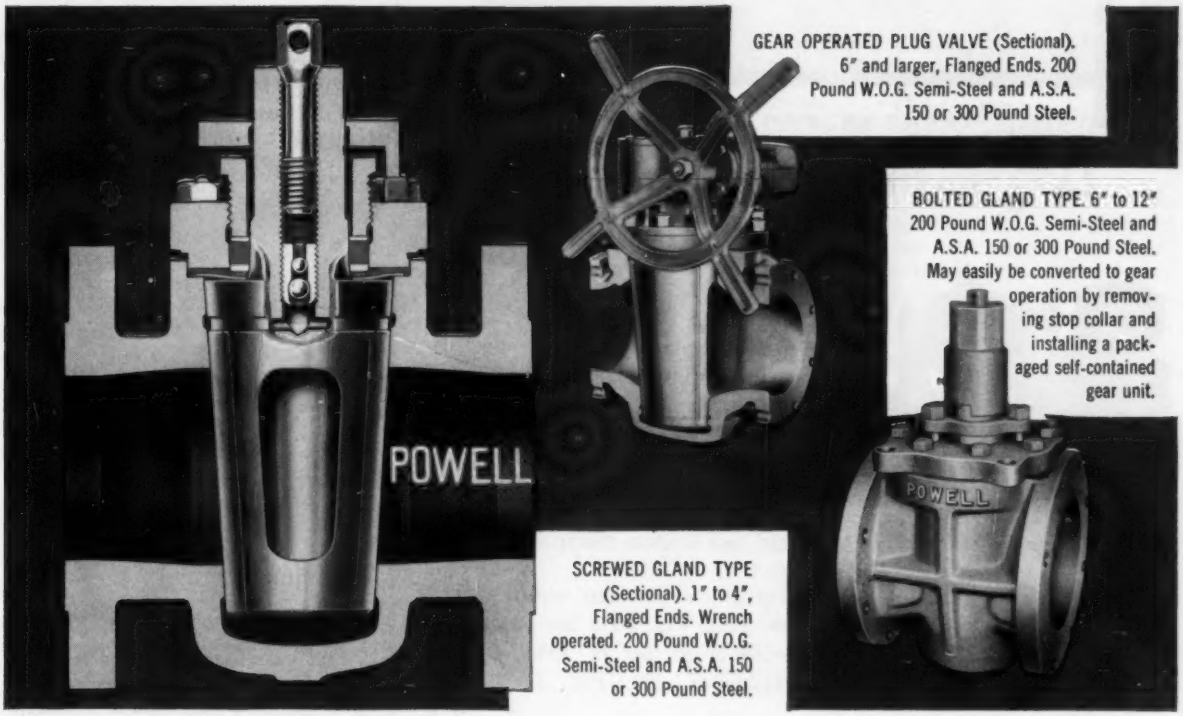
Impurities remaining in the distilling vessel, usually called an evaporator, must be periodically or continuously removed. Scale is cracked off the heat-transmitting surfaces or a portion of the concentrated solution remaining in the evaporator is blown down.

Usually steam is supplied to coils or tubes in the evaporator and the heat transmitted causes the water to steam. In most power plants the boiler feedwater absorbs the heat in the evaporator steam, thus condensing the pure vapor and producing high quality makeup with little heat loss.

Distillation removes only dissolved solids. Ammonia, oxygen, carbon or sulfur dioxide usually pass off with the vapor. So distillate must usually be deaerated. If the evaporator feedwater contains much carbonate or bicarbonate, the elements may be partially broken down by the heat, releasing

POWELL

Lubricated Plug VALVES



GEAR OPERATED PLUG VALVE (Sectional). 6" and larger, Flanged Ends. 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel.

BOLTED GLAND TYPE. 6" to 12" 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel. May easily be converted to gear operation by removing stop collar and installing a packaged self-contained gear unit.

SCREWED GLAND TYPE (Sectional). 1" to 4", Flanged Ends. Wrench operated. 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel.

Powell Lubricated Plug Valves maintain our 110-year tradition of quality and precision. Only the finest available materials are used. And painstaking quality control is rigidly enforced through each and every step of manufacture.

Features include quick and positive operation—just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

Valve users who want one source of supply for lubricated plug as well as all types of bronze, iron, steel and corrosion-resistant valves will want full details on Powell Lubricated Plug Valves.

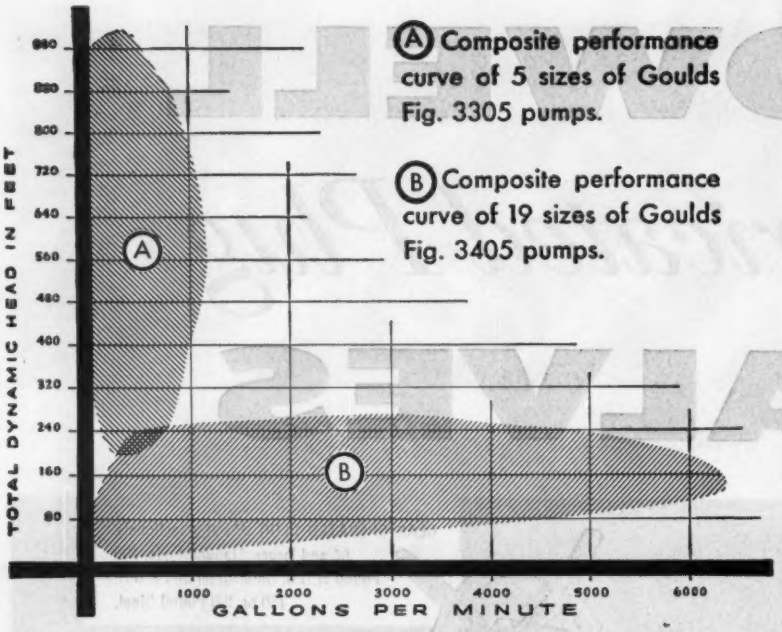
Available in Steel and Semi-Steel through distributors in principal cities. If none is located near you—or if you need help on valve problems—write direct to

PERFORMANCE PV VERIFIED

BRONZE, IRON, STEEL AND CORROSION-RESISTANT VALVES

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

The source of supply for all valve needs!

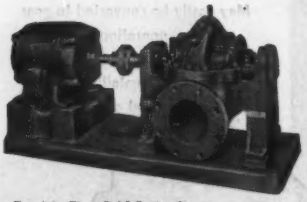


Ⓐ Composite performance curve of 5 sizes of Goulds Fig. 3305 pumps.

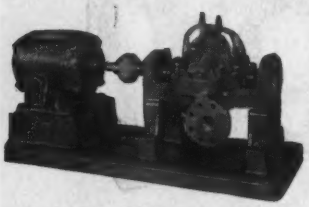
Ⓑ Composite performance curve of 19 sizes of Goulds Fig. 3405 pumps.

Do you need pumping capacity?

. . . or head? . . . or both?



Goulds Fig. 3405 single-stage pump.



Goulds Fig. 3305 two-stage pump.

With these two groups of Goulds centrifugal pumps you can meet an extremely wide range of pumping requirements.

For volume pumping, 19 sizes of the Fig. 3405 single-stage, double-suction pump provide capacities up to 6,400 GPM, and heads to 280 ft.

For greater pressure requirements 5 sizes of the Fig. 3305 two-stage pump provide heads up to 1,000 ft., and capacities to 1,200 GPM.

Both of these groups of pumps have important new design and construction features that insure efficient operation and long life. Yet, because so many of their parts are interchangeable, *you can cut your parts inventory in two—or better.*

For example, you need only 3 different shafts for all 24 sizes of pumps in both groups.

We'd like to send you additional details about these pumps, including specifications and performance curves. Just write for Bulletin 721.6 about the Fig. 3405 single-stage pumps, and Bulletin 722.6 about the Fig. 3305 two-stage pumps. We'll be glad to send you copies of both.

MEMBER

Goulds PUMPS INC.
Seneca Falls
New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA • PITTSBURGH • TULSA

WATER TREATMENT

Continued from page 210

large quantities of carbon dioxide.

Evaporators may be of the single- or multiple-stage type. The latter uses vapor from the first or highest-pressure shell in the coils of the next-lower pressure shell. Vapor from this shell may be carried to coils of the next lower one, etc. The multiple effect reduces the quantities of live steam and condensing water required for a given distillate output, but calls for more equipment and somewhat more complicated operating procedure.

If solids are allowed to concentrate in the evaporator shell (1) they will deposit out as scale on the coil surfaces, thus reducing evaporator capacity or (2) priming and foaming will occur, causing carryover of impure water with the vapor. Distillate purity is severely decreased.

If the feedwater is not softened, scale is usually produced. Evaporator coils are usually shaped to cause the scale to crack off. This tendency is enhanced by periodically allowing a sudden inrush of cold water in the shell or hot steam in coils that have cooled. The sudden temperature changes crack scale off the coils.

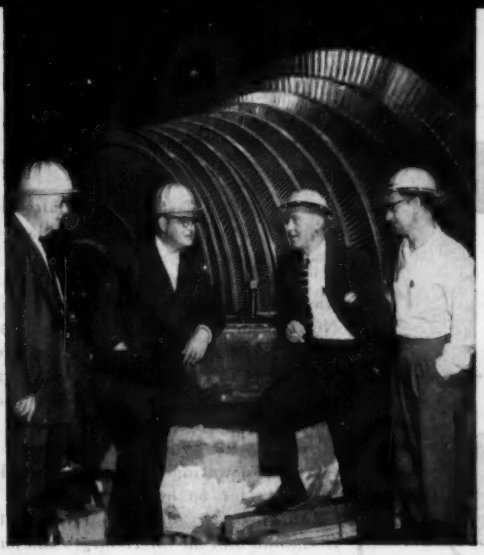
If feedwater is softened, scale does not form as a rule, but total solids in the shell water must be limited to perhaps 3000 to 5000 ppm to prevent foaming and carryover. Feedwater is usually preheated and aerated to remove dissolved gases and partly break down carbonates and bicarbonates.

MARMADUKE

Continued from page 146

That safe harbor for beached seafarers, waterfront characters and retired operating engineers was bulging with activity. I could make out Marmy in the smoke-filled interior, at one of the crowded tables. With napkin wrapped around his neck, he was just finishing his favorite fuel of corned beef and cabbage, and washing it down with a bottle of Sandpaper Gin. His shipmates did all the talking. As usual, Marmy was too busy with the business at hand to be bothered. Pushing the empty bottle to one side, he stuck a piece of rope yarn into his face, revvied up his induced-draft fan, applied his torch and then sent a cloud of Ringelmann Number 8 smoke into the already-smog-filled atmosphere.

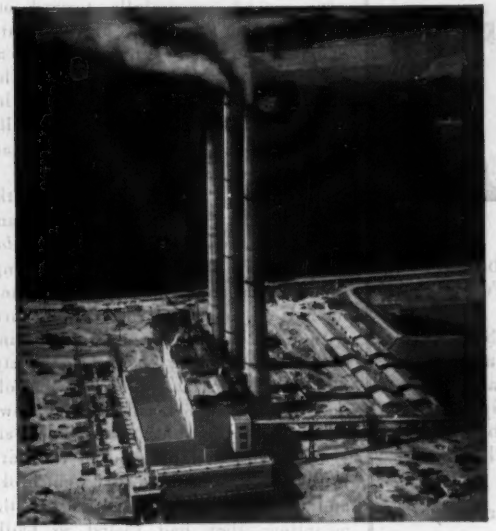
Strong men seated near Marmy coughed violently. Some wiped tears from their eyes. But our hero glowed with satisfaction as he blotted out his shipmates with cloud after cloud of



Robert Higgins, Howard Barr, John Dunnewind and H. I. "Hi" Lamphier (left to right) discuss lubrication of equipment at Clifty Creek plant. Howard Barr and Hi Lamphier are plant manager and assistant plant manager respectively. Standard Oil men Bob Higgins, industrial lubrication specialist and John Dunnewind, chief lubrication engineer provide lubrication technical service to customers. Together they have more than 38 years experience in such work—Bob 18 years, John 20. John has an engineering degree from the University of Michigan and is a graduate of Standard's Sales Engineering School. Customers of Bob Higgins and John Dunnewind find this kind of experience and training pay off *for them.*

Clifty Creek management selects NONPAREIL Turbine Oil—

—receives life-of-turbine guarantee for the oil



Approximately 60,000 gallons of NONPAREIL Turbine Oil were purchased for Clifty Creek, most of which are to be used to fill lubrication systems. Kilowatt capacity of installation will slightly exceed that of Hoover Dam.

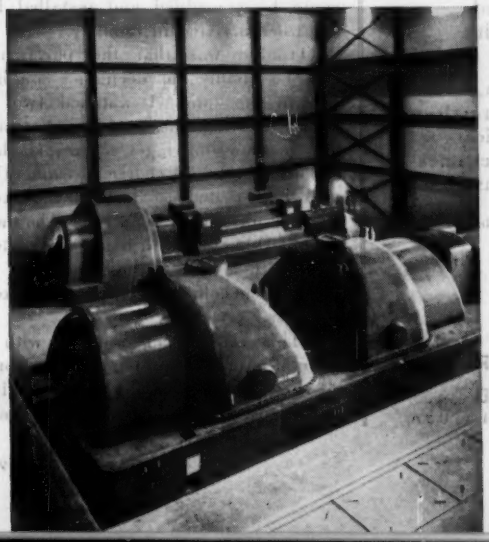
Power and lots of it has been ordered for the AEC gaseous diffusion plant near Portsmouth, Ohio. Clifty Creek Plant in Indiana is the larger of two plants being built by Ohio Valley Electric Corporation to supply this demand. Six giant turbo-generators will be housed in the Clifty Creek plant. Combined capacity will be 1,290,000 kw.

NONPAREIL Turbine Oil will be the lubricant for Clifty Creek's six 215,000 kw. turbines. The oil is guaranteed, for the life of the turbines, not to exceed a neutralization number of 0.15 mg.KOH/gm.

Six other important benefits are obtained by the use of NONPAREIL Turbine Oil:

1. Correct viscosity to lubricate without excessive fluid friction.
2. Good demulsibility to permit removal of water which unavoidably gets into the oil.
3. High oil stability to insure resistance to oxidation and sludging.
4. Low pour point for fluidity at any operating temperature normally met.
5. Resistance to foaming, with special additive to counteract foaming tendency.
6. Capacity for protecting metal parts against corrosion.

Clifty Creek turbines join more than 800 other turbines now using NONPAREIL Turbine Oil, some for as long as 29 years. Inquire about NONPAREIL Turbine Oil of your Standard Oil industrial lubrication specialist in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Ill.



NONPAREIL Turbine Oil guarantee that will hang beside each of the six turbines at Clifty Creek.

STANDARD OIL COMPANY
(Indiana)

STANDARD

Bendix-Friez

AEROVANE* SYSTEM

TRANSMITTER

RECORDER

INDICATOR

CONTROLLER (Windtrol†)

...helps solve air pollution problems

Chances are, the Bendix-Friez* Aerovane System can be a big help to you in offsetting air pollution problems. For example, if wind speed and direction are an important factor in your problem, here's one way the Aerovane System can help. When wind speed reaches a pre-set value and wind direction falls within an undesirable sector, the Aerovane controller will automatically actuate operating equipment such as fans, blowers, heaters, etc. The entire system can be used in dozens of plant applications. Or, any one of the units can be purchased for use with the transmitter.

TRANSMITTER—Detects wind speed and direction. Electrically sends information to indicator, recorder and controller.

RECORDER—Inks the wind speed and direction on time calibrated chart. Has three speeds for 1½-, 3- or 6-inches per hour. Under normal 3-inch-per-hour setting, recorder operates continuously for two-week period.

INDICATOR—Shows wind speed and direction. Illuminated dials, white over black markings for maximum legibility. Calibrated in degrees of compass and miles per hour.

CONTROLLER—Actuates circuits, turns on alarm system, operates other equipment when wind speed and direction reach pre-determined settings. Wind speed and wind direction dials mounted on face. Automatic time delay device compensates for fluctuating wind direction and speed. Time length is adjustable.

Write today for complete information. *Reg. U. S. Pat. Off. †Trade-mark

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MARMADUKE

Continued from page 212

acrid smoke. I eased into a chair a few tables away and nodded to Bedlam for a short beer.

"How about the time Josh Moriarty was closed up inside the steam drum of No. 14 boiler on the old *Leviathan?*" asked a hoarse voice amid coughs, from somewhere inside the blackout area near Marmy. "And the only thing found of poor old Moriarty when we opened up the boiler in Cherbourg . . ." started answering another voice, but that's as far as he got.

"BILGEWATER on Moriarty, on the *Leviathan* and on Cherbourg," suddenly blasted Marmy in his foghorn voice as he surveyed his audience defiantly. "I'll tell you bilge divers about the time I saved a ship yard plenty of money and all I did was use my head and a bottle of magic juice."

That did it. All activity stopped—all eyes turned respectfully toward our hero. After all, when Marmy starts sounding off, there's nothing you can do *but* listen. Marmy pushed back his chair, crossed his sturdy legs, gave his size-8¼ gray bowler a starboard list on top of his seaweed-covered head, then blasted away.

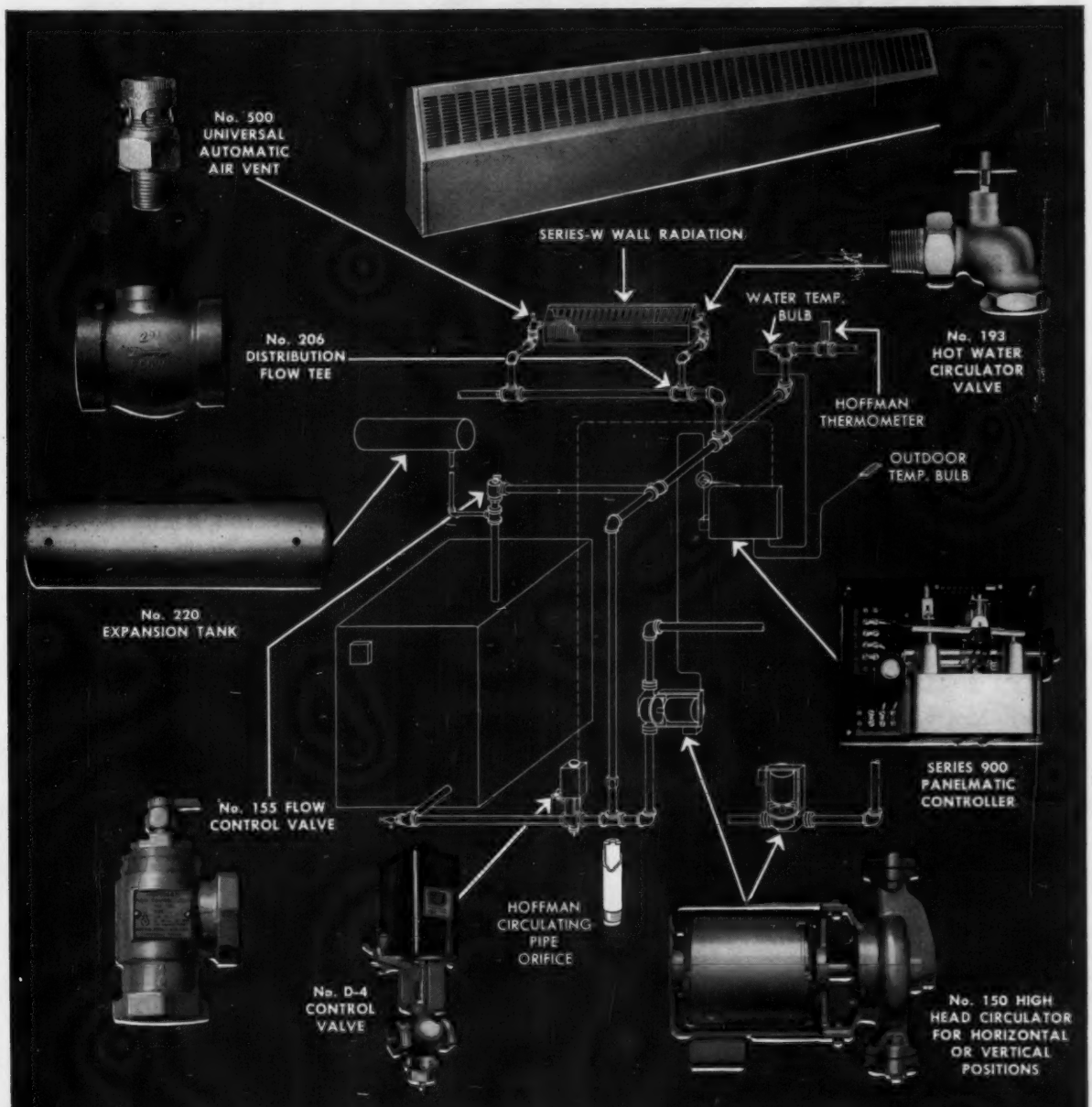
"Back in 1934, I pulled into the Pasamagula Shipyard in Louisiana aboard the molasses tanker *SS Cuba.* We were in for our annual dry docking. Snooping around the yard that afternoon I saw a pile of rusty crane parts with a dozen yard mechanics working on them. But they seemed to be stymied. The foreman told me ten old dock cranes had been shipped down from a large pier at New Orleans six years before and dumped in the yard for overhaul. But the owner went broke and the cranes were forgotten. In the meantime, they had rusted so badly they looked like scrap.

"A few months before, a speculator had bought the ten cranes and sold them to a firm in India. The shipyard was to recondition the parts so they could be assembled and installed for use when arriving in Bombay.

"Trouble was that the parts had rusted so badly the mechanics couldn't remove the nuts. I watched two of them sweating on a 4-inch-diameter by 6-feet-long outrigger screw-jack that had U.S. Standard coarse threads. The nuts had rusted so fast they looked like one piece with the screw. The men pounded the nuts with hammers, heated them with a blow torch, then tried to screw them off. But the job looked hopeless.

" 'This yard's been working with a skeleton crew for so long that we won't give up—we need jobs too badly,' wailed the foreman. 'But I know we'll

HOFFMAN COMPLETE EQUIPMENT
FOR HOT WATER HEATING SYSTEMS


No. 500 UNIVERSAL AUTOMATIC AIR VENT
SERIES-W WALL RADIATION
WATER TEMP. BULB
No. 206 DISTRIBUTION FLOW TEE
No. 193 HOT WATER CIRCULATOR VALVE
HOFFMAN THERMOMETER
OUTDOOR TEMP. BULB
No. 220 EXPANSION TANK
SERIES 900 PANELMATIC CONTROLLER
No. 155 FLOW CONTROL VALVE
HOFFMAN CIRCULATING PIPE ORIFICE
No. D-4 CONTROL VALVE
No. 150 HIGH HEAD CIRCULATOR FOR HORIZONTAL OR VERTICAL POSITIONS

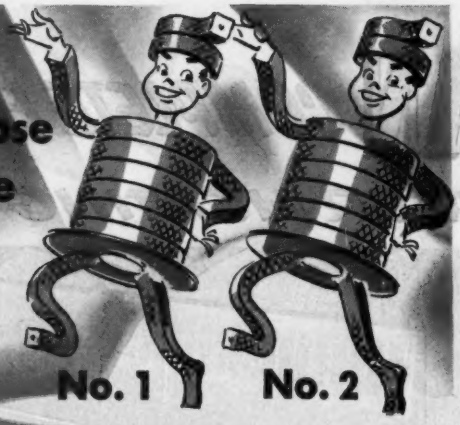
EVERY HOT WATER SPECIALTY YOU NEED—from ONE COMPLETE LINE

Now you can specify Hoffman products for every spot on a hot water heating system—with three important advantages to you. First, you are assured uniform operating efficiency; second, it saves time from buying to billing; third, it provides one uniform guarantee from a single, recognized source. And, in addition, builders are quick to appreciate the sound Hoffman design features that cost no more than ordinary kinds. New Bulletins on High Head Circulators, Flow Control Valves, Expansion Tanks, Flow Tees, Circulator Valves and Wall Radiation are available, free, no obligation.

HOFFMAN SPECIALTY MFG. CORP. • 1700 West 10th Street, Indianapolis 7, Indiana

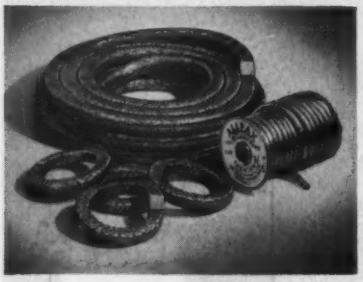
Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps . . . Sold by Leading Wholesalers of Heating and Plumbing Equipment

These All-Purpose Twins Cover the PACKING FRONT!



These two styles of Allpax Packing cover a wide range of applications and many different uses, consistent with the policy of our company—fewer packings for more services.

Both are compounded of the highest quality materials, and between them they cover against such service conditions as steam, water, air, ammonia, gases, oils, distillates, dowtherm, etc. They are for use on centrifugal and rotary pumps, valve stems, expansion joints and similar equipment.

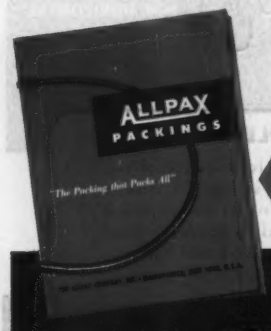


Packaged in durable metal containers to insure protection and preservation of material. Applications and uses conveniently noted on each container.

Style No. 1 is really universal in its uses—where the temperature does not exceed 600 degrees F.

Style No. 2 also has an extremely wide variety of uses in higher temperatures, ranging from 600 degrees F. to 1200 degrees F. This is because of a special bonding compound, containing a heat-proof lubricant, which maintains the lubricant under high temperature conditions.

Both types are made in ring, spool or coil form in a wide variety of sizes. Allpax Packings do a better job for manufacturers and replacement use because they are precision-made, accurate in dimensions. They provide a tight seal without danger of scoring or unnecessary wear.



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"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials.
Distributors in principal cities.

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

MARMADUKE

Continued from page 214

never get those nuts off. We soaked them in penetrating oil all night—but it's still no use.'

"Just then the yard super barged up and watched the mechanics for a minute. Then he asked the foreman how his men were doing. Before the foreman could answer he turned to me. 'I hate to have new jack screws made because we're just breaking even on this job, gives our boys something to do. But it looks like we won't get those damn nuts off in a month of Sundays,' he squawked, grinding his cigar stub into the dirt with his heel.

"'I'll get them off and all I need is one man to hold the wrench on one end and another to screw off the nuts,' I told him. Before he could answer I continued, 'You've got 40 screws. Give me $50 and I'll have those nuts off by noon tomorrow. If I don't, you won't owe me a cent.' That proposition lowered the boom on the super, but he was interested.

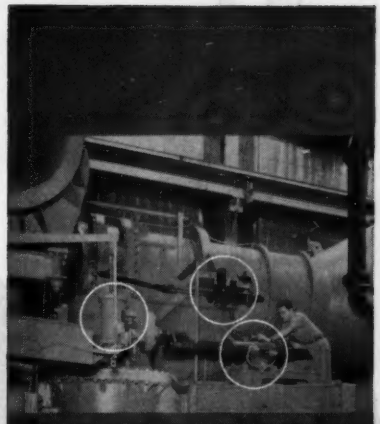
"After thinking it over, he asked me to walk into the master mechanic's office. I repeated my offer. After some haggling, they both agreed they couldn't lose. Besides, I could see they didn't believe I could deliver. The mechanics were told to knock off the screw job. Two of them were asked to work with me, starting at 8 o'clock the next morning.

"There was a lot of speculating around the yard that afternoon. The boys wondered what the chief of the *SS Cuba* was going to do. I wasn't talking, and I let them wonder.

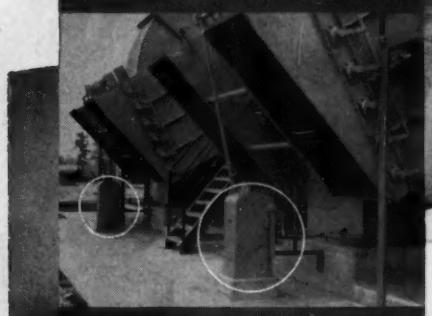
"That night after all the yard workmen went home, I rounded up two of my oilers aboard ship and asked them how they'd like to make a little pocket money. They jumped at the chance because they were paid less than 60 dollars a month in those depression days. Maybe they could have a good time ashore after all.

"Next morning the big shots from the yard office showed up at 8 am on the dot. A lot of yard workmen, as well as my ship's gang, were on hand to see how I'd save those big bolts. The yard boys were surprised to find the bolts in one pile, covered with wet burlap sacks.

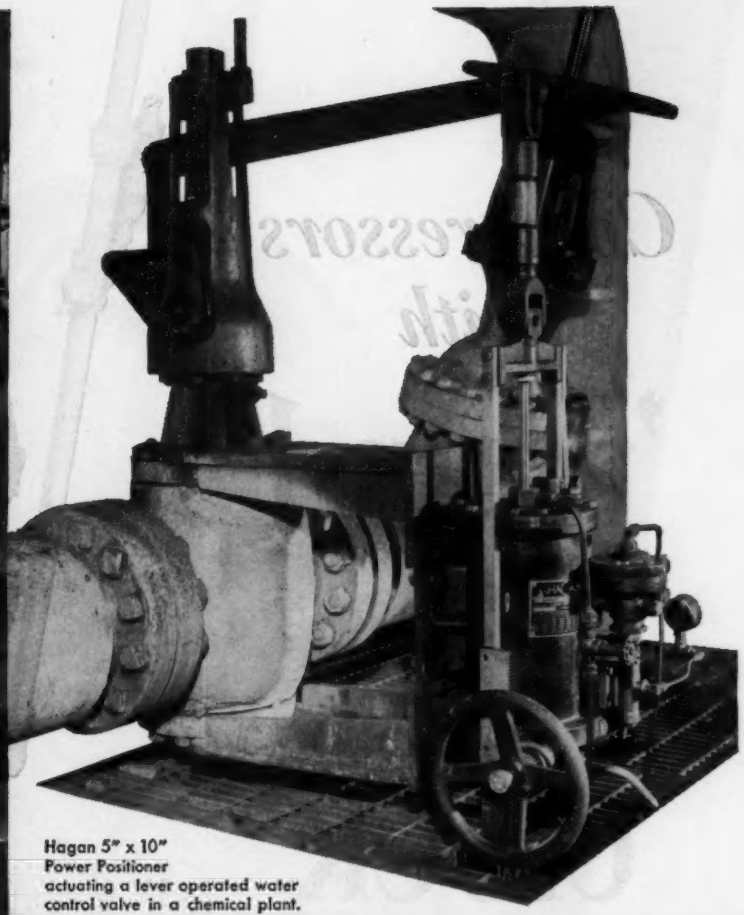
"I had a mechanic remove a bolt from under the dripping burlap and place a wrench on one end. Then I pulled a quart vinegar bottle from my pocket that I got from our ship's cook. It was filled with a clear white liquid and was stoppered with a cork that had a hole drilled through it. While everyone crowded around, I took a purple tablet from my pocket and dropped it



Two 8" x 20" and one 5" x 20" Hagan Power Positioners operating plug valves on a wind tunnel in an aeronautical test facility.



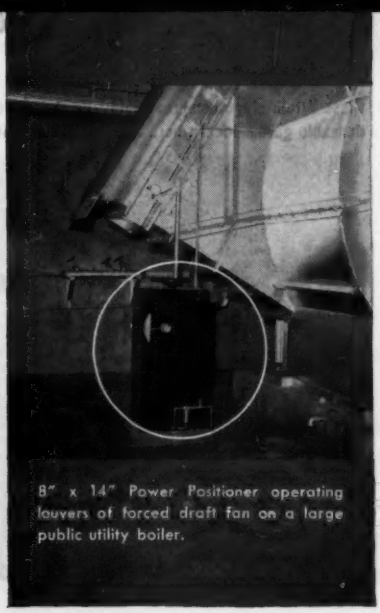
Louvers on forced draft fans operated by Hagan 6" x 10" Power Positioners. Note outdoor installation.



Hagan 5" x 10" Power Positioner actuating a lever operated water control valve in a chemical plant.

HAGAN POWER POSITIONERS

HIGH PRECISION—LOW MAINTENANCE!



8" x 14" Power Positioner operating louvers of forced draft fan on a large public utility boiler.

Hagan Power Positioners provide the "muscles" for thousands of control applications in every type of industry—wherever torque and positioning accuracy requirements are severe.

Hagan Power Positioners are economical, both in first cost and in the low maintenance costs which result from their uncomplicated design and strong construction. Many Hagan units are still giving trouble-free, dependable service after years of exposure to rigorous conditions, such as high ambient temperature (up to 160°), corrosive atmospheres, or outdoor installations.

Hagan Power Positioners can help you lower costs in all your final power drive needs. Write for Specification File TP-MFI for information on the full range of these powerful "Muscles for Industry."

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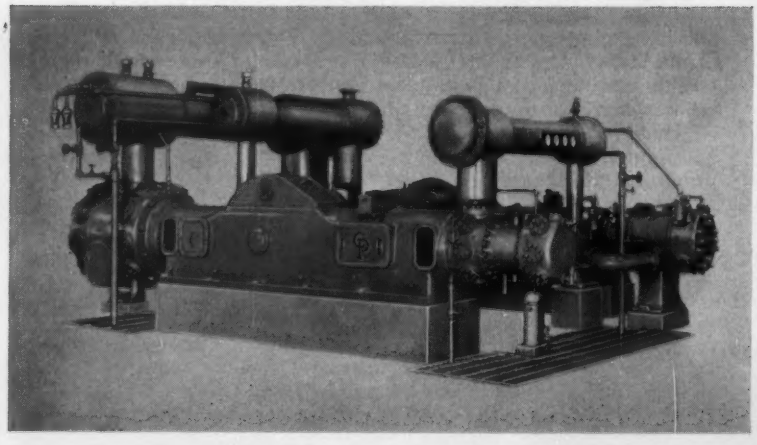
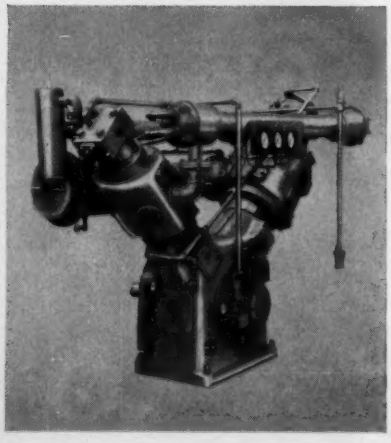
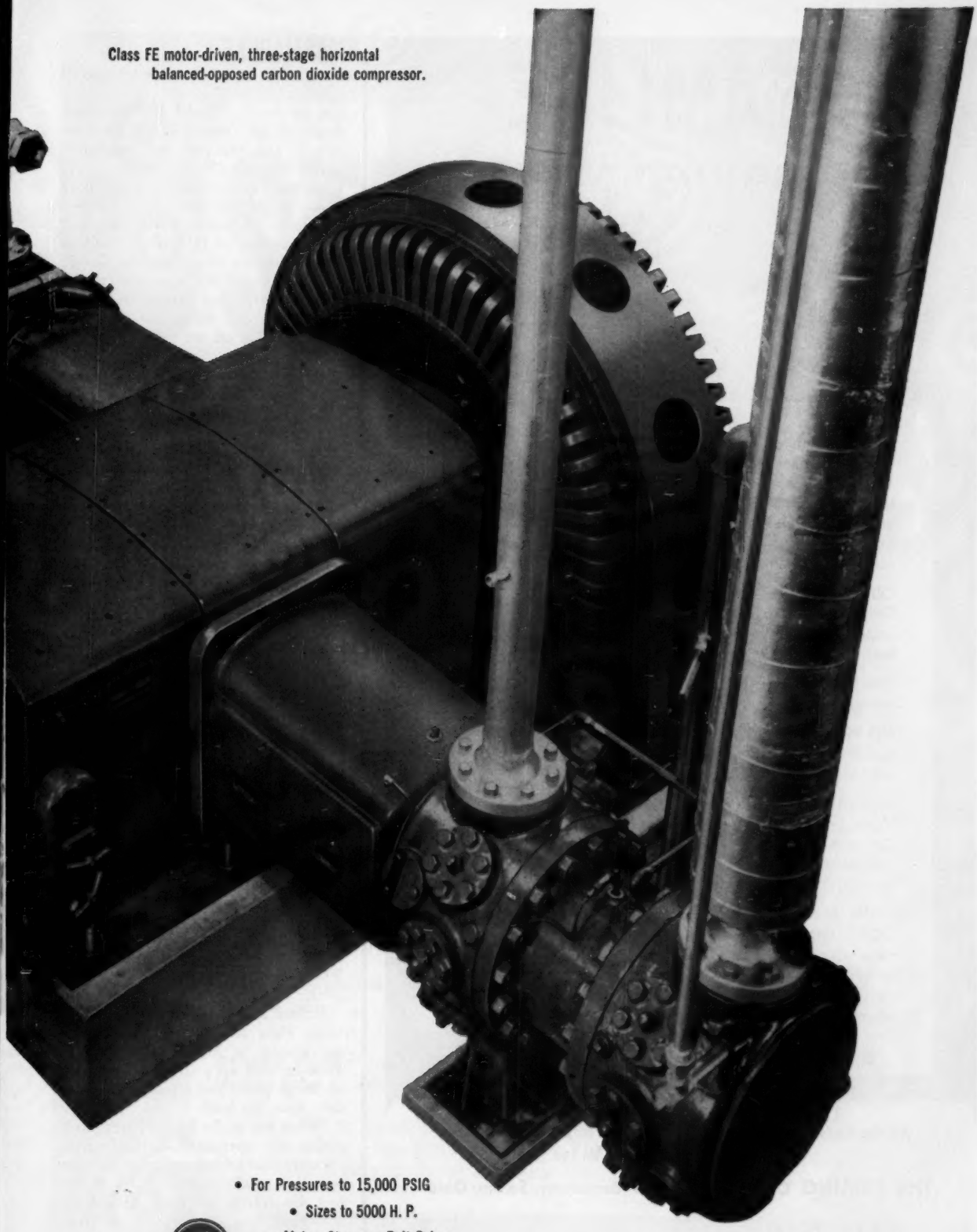


Class Y four-stage compressor for air and non-condensable gases. Ideal where floor space is limited.





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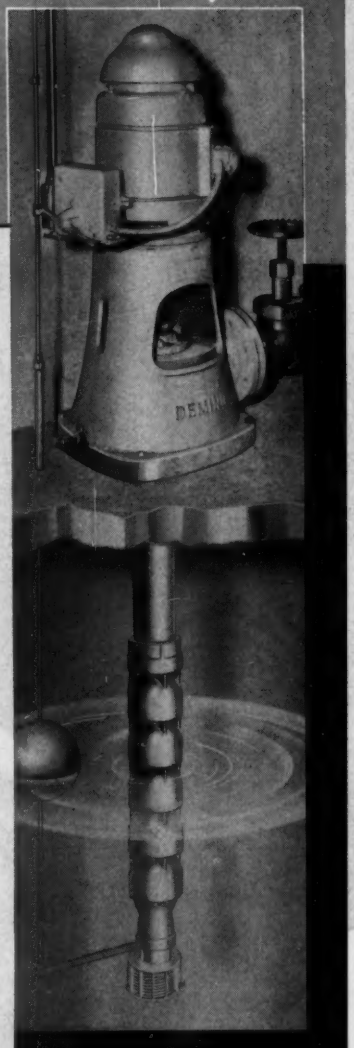

A wide variety of liquids are handled by Deming Vertical Turbine Pumps in diversified industries. Advantages over conventional pumps in comparable services include the following:

COMPACTNESS: A Deming Turbine with a 250 H.P. motor requires floor space only 3 feet square.

SIMPLIFIED PIPING: No suction piping required.

NO PRIMING PROBLEMS: Pumping element always submerged.

FLEXIBILITY OF DESIGN: Vertical multi-stage construction permits selection of correct number of stages for head and maximum efficiency.

LOW MAINTENANCE COST: Heavy duty, *vertical* construction eliminates side thrust. Centered discharge column permits accurate alignment.

All the facts on Deming Vertical Turbine Pumps are necessary to judge their advantages. Write:

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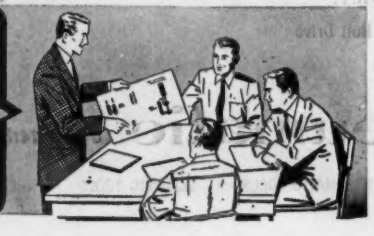

MARMADUKE

Continued from page 216

into the bottle. Then I squirted a few drops of the fancy liquid over the threads and told the two mechanics to run the nuts off.

"'I don't know what the magic juice is you got in that bottle, Chief,' ribbed the master mechanic, 'but if that stuff gets those nuts off I'll buy you the best doggone shrimp dinner you ever had in town tonight.' My audience roared with laughter. But before the master mechanic could finish, the two men were screwing off the nuts.

"'Gosh—they almost come off by themselves,' said one surprised mechanic.

"'Hey, Chief, watcha got in that bottle?' asked someone in the crowd as everyone rubbernecked in amazement at those two men twisting off the nuts.

"'Like the master mechanic here says,' I answerd sarcastically, 'it's magic juice.' That's all I'd tell them. The nuts came off all those 40 jack screws just as easy as that first one. The men who had been pulling their arms off for a few days and getting nowhere could hardly believe those screws were the same pieces.

"'You win,' said the super in his office as he handed me the 50 dollars. Aboard ship I divvied up with my boys who had helped me the night before. That evening I went ashore with the master mechanic and had the best creole-style shrimp dinner a guy could ask for."

With that off his chest Marmy stopped talking, lit up his rope yarn and called over to Bedlam for another bottle.

"Ahoy," yelled a weather-beaten old marine engineer from a corner table. "I worked with all kinds of rusty metal for years, but I never heard of any magic juice that worked like that. What in hell did you have in that bottle?"

Marmy leisurely ballasted his deep tanks while all ears strained to hear the answer to his amazing miracle. Then he built up a 16-inch vacuum on his cargo pump and topped off his settlers from his bottle.

"What was in the bottle?" he roared, giving his questioner a tough look. "Water—that's what my magic solution was—just plain water. Water is the best dissolver in the world. I had my boys hang those 40 screws in the drink from the dock the night before. During the night, the water worked into the rust and loosened it. We took them out just a few minutes before the yard men started showing up. To keep the screws wet, we covered them with soaked burlap. I didn't have to squirt my magic juice on those bolts,

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tough—semi-steel, cast steel or forged steel construction takes hard usage . . . lasts a lifetime

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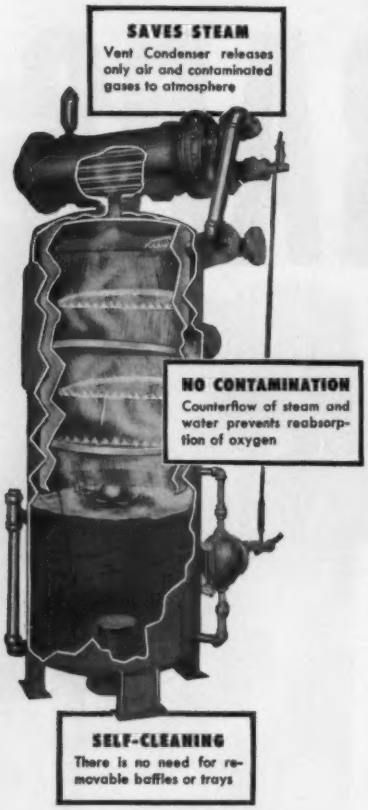
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Stickle Equipment
Cuts the cost of steam

MARMADUKE

Continued from page 220

they were already loose after that all-night bath.

"Don't you lads ever forget it," roared Marmy in his bullfrog voice, as he pounded the table for emphasis. "The next time you got a rust problem, use the stuff that made it rust in the first place—my magic juice—water, just plain unadulterated water."

"Oh, yea?" blurted out another weather-beaten character standing at the bar. "If that magic juice was plain water, what in hell was that purple tablet you slipped into the bottle?"

"That," bellowed Marmy, standing up to his full height of 6 feet 4 inches and heading for the door, "was a tablet of potash I happened to have in my pocket. But it had nothing to do with loosening that rust. You engineers oughta know you gotta feed people a lot of hocus-pocus when you save them money with a ridiculously simple solution. The yard boys thought that potash pill was worth $50 only because it made them believe they were buying magic juice."—*SME*

THREE CHEERS FOR POWER

The Marmaduke Story is interesting and amusing. I think considerable credit is due POWER for introducing these stories in a technical magazine.

R O ISENBARGER *Chicago, Ill.*

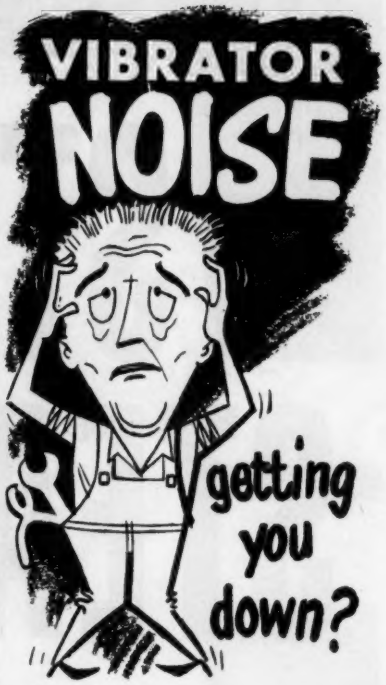
ELECTRODES

Continued from page 82

Operator must be taught that the operating current range for iron-powder coated electrodes is about half that generally expected of the conventional type. Operation below this range sacrifices penetration. Trying to get faster welding speed by using higher currents results in excessive porosity. Operator training in sensible current control is a *must* to produce sound wels of good appearance.

Today, as a result of consumers' demands and competition among reputable manufacturers, the iron-powder coated electrode is vastly improved over the 1953 offering. Used properly, this new electrode is an important contribution to both production and maintenance welding operations.

EDITOR'S NOTE: *Author Howard, interrupted in writing this article by telephone's insistent ringing, dashed to Berwick Hospital on Leap Year Day to greet new arrival Barbara Ann (fourth little Howard) who weighed in at 8 lb, 5 oz. Congratulations, Don!*



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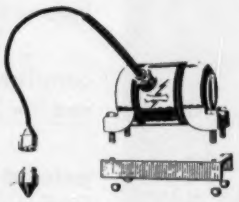
For detailed information, write for our new Electric Vibrator Catalog.



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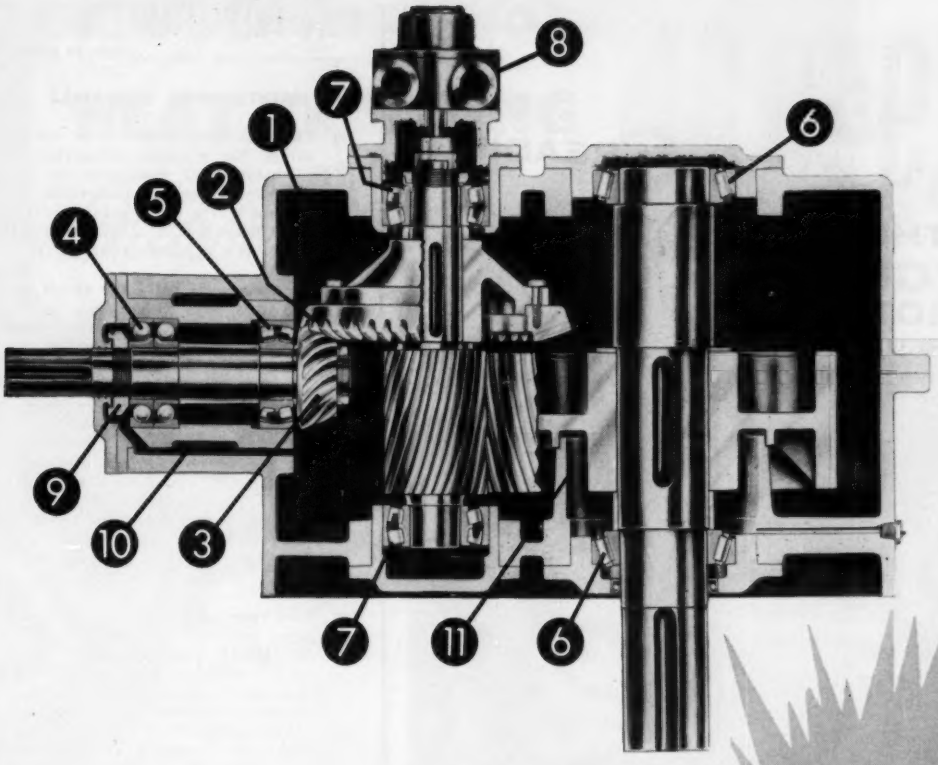

Sectional view of a Double Vertical Type Philadelphia Spiral-Bevel Speed Reduction Unit.

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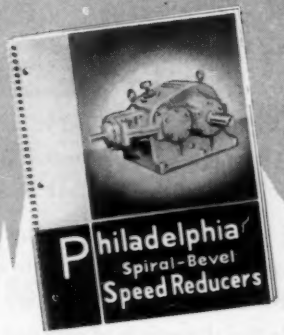

. . . make us tell you the "11 points" of superiority of PHILADELPHIA SPIRAL-BEVEL REDUCERS

These units offer a compact, dependable and highly efficient means of transmitting power at right angles. They are available for Vertical (shaft-up, or shaft-down) or Horizontal Mounting; in single, double or triple reductions . . . Reduction Ratios range from 1.5 to 1 up to 238 to 1.

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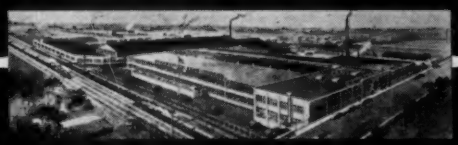

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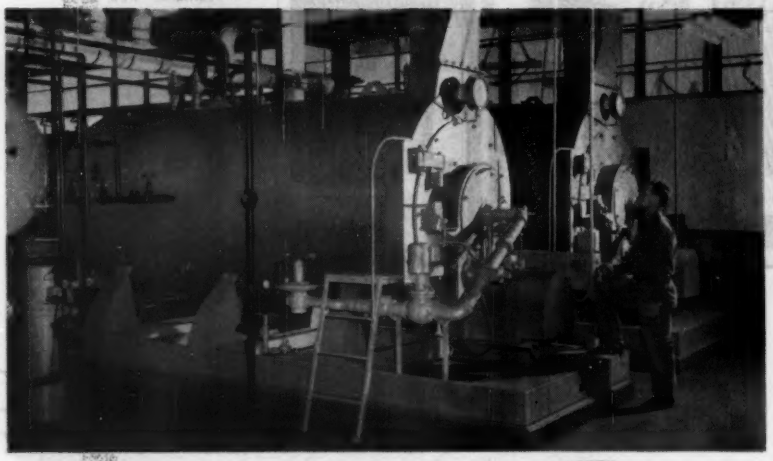

Too *high*—said the Zion Cooperative Mercantile Institute, Salt Lake City, of its 1953-1954 heating costs. ZCMI is the largest wholesale distributor in the intermountain area.

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More FREE LITERATURE

Begins on page 167

MAINTENANCE MATERIALS

9 **Thermal insulations** and refractories for general industrial applications are discussed in 20-p bulletin. Covers materials for control of temperatures from -400 to +3000 F. Johns-Manville, 22 E 40th St, New York 16, N. Y.

10 **High-capacity filter** for diesel fuel and lube, pipelines, process liquids, water, gasoline and aviation fuels is described in 4-p catalog MK-170. Includes specs, flow rates and engineering drawings. Cuno Engineering Corp, Meriden, Conn.

11 **Removal of rust** and lime scale by simple soaking or circulating is subject of pocket-size folder F9688. Describes action of an inhibited liquid descalant, said to end mechanical scraping or rodding out. Oakite Products, Inc, 19 Rector St, New York 6, N. Y.

12 **Rust prevention.** Illustrated 28-page general catalog 255 gives details of rust-preventive products including primers, oil-type coatings, heat-resistant coatings, chemical-resistant coatings, oilfield finishes, floor and deck coatings, etc. Included are 102 color chips. Rust-Oleum Corp, 2799 Oakton St, Evanston, Ill.

MATERIALS HANDLING

13 **Equipment** for handling bulk material such as rock, gravel and coal is described in illustrated 34-p bulletin 955. Includes information on conveyors, chain, feeders, elevators, hoppers and drives. McNally Pittsburg Manufacturing Corp, Pittsburg, Kan.

14 **Bucket elevators** for lifting vertically bulk materials are subject of illustrated 4-p bulletin. Contains full specs, dimensional data, features. The Bucket Elevator Co. 360 Springfield Ave, Summit, N. J.

15 **Autotronic elevators.** Illustrated 24-p booklet A-413 describes without-attendant designs that are completely automatic in their operation. Six- and four-program systems of operation are included. Otis Elevator Co, 260 11th Ave, New York 1, N. Y.

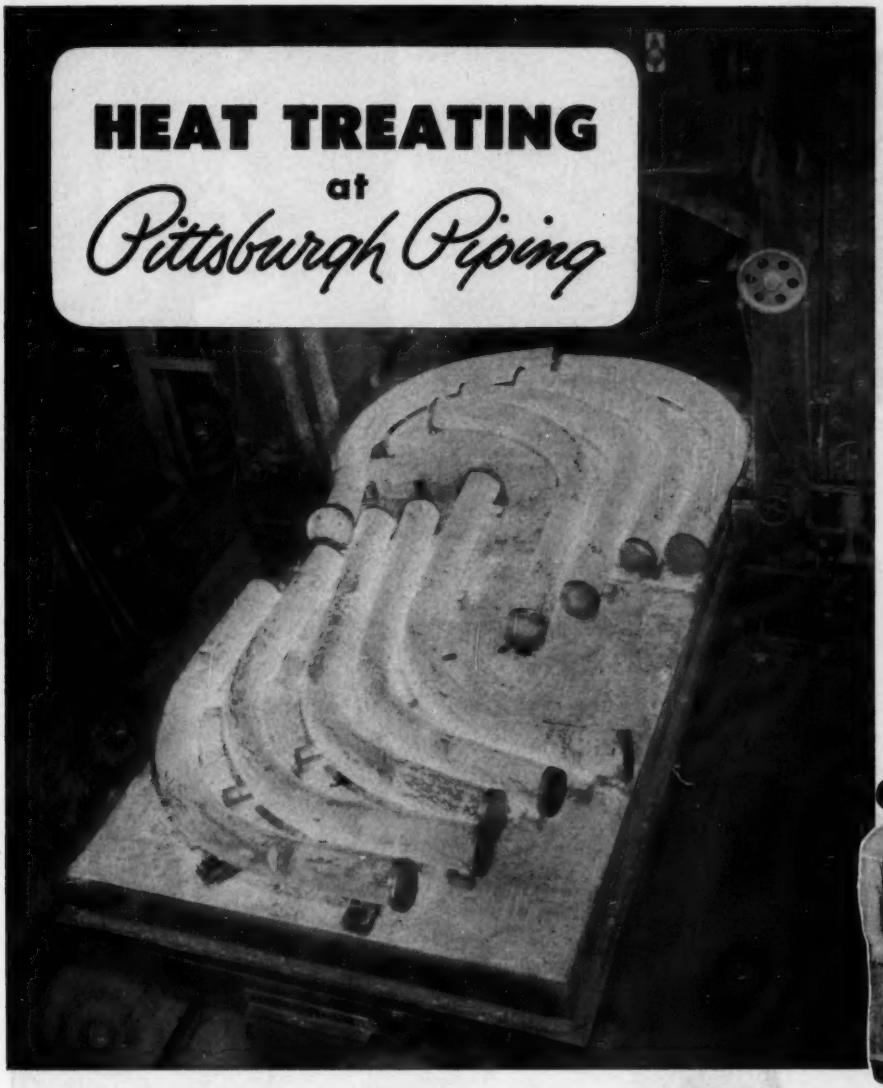
16 **Cranes.** Illustrated 40-p bulletin M-100 covers power-house, general-service, light-duty, mill-service and bucket designs and other heavy-material handling equipment. Clearance dimensions, maximum wheel loads, rated capacities and other data are given. Dominion Bridge Co Ltd, Lachine, Que, Canada.

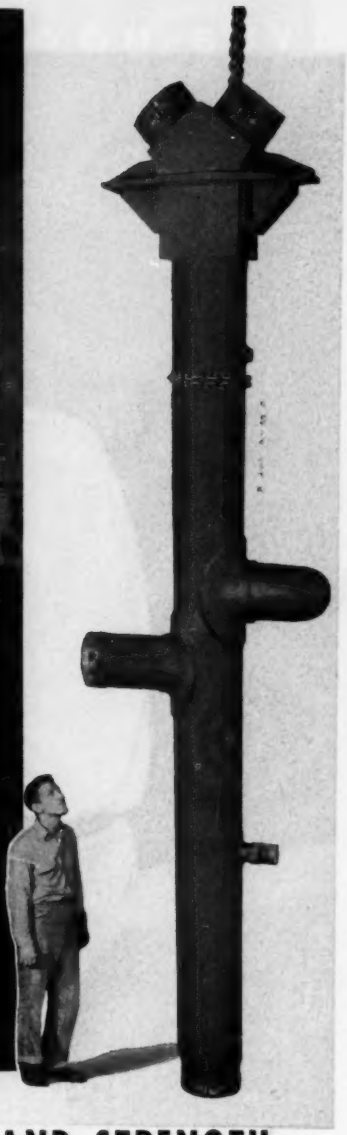
MECHANICAL TRANSMISSION

17 **Roller bearings.** Illustrated 8-p bulletin 2658 describes *Series S* adjustable single-row self-aligning bearings, *Series D* adjustable double row bearings and *Series M* pre-adjusted double-row self-

(*Continued on page* 227)

HEAT TREATING at Pittsburgh Piping





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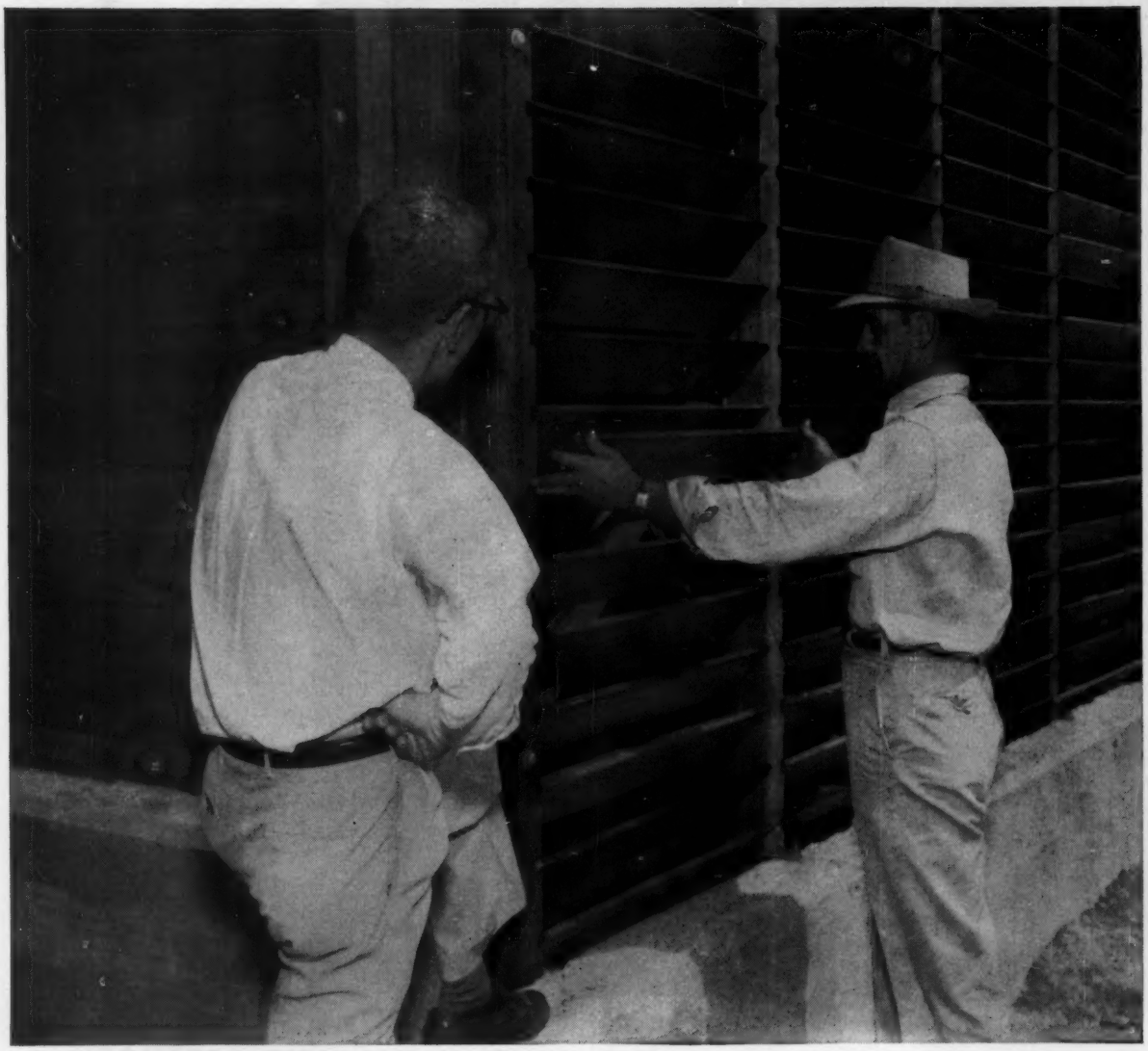


"Now, let me show you what Pritchard has done on the inside!"

"On the inside? I thought we were taking about louvers!"

"We are, Mr. Wilson, but there is something you can't see from the outside of this Pritchard tower. Just let me slip this louver board out and I'll show you what I mean."

"They slip in and out of those slots easily, don't they?"

"Yes, they do. These Type C louvers make it easy to get into the tower. Now, take a look at the way those strippers have been placed above the louver openings and the arrangement of the posts and ties."

"Is that important?"

"Very! It stops undesirable splatter which otherwise would cause icing-up in cold weather."

"Ice is a serious problem, isn't it?"

"Not when we're as far south as this tower is, but farther north where winters are rugged, we specify Pritchard's Type WX louvers! They are designed especially for cold weather climates. Design features like staggering the louvers so there is no run-off to cause ice build-up, make the Type WX louver ideal for use in cold climates."

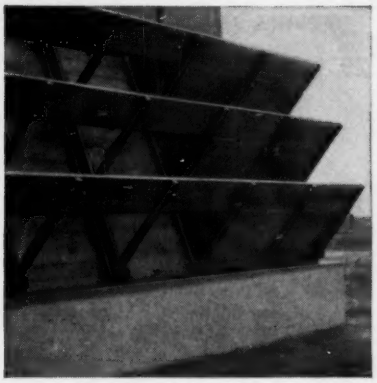
"Anybody else build them that way?"

"No! Just Pritchard!"

J. F. PRITCHARD & CO. OF CALIFORNIA
4625 Roanoke Parkway, Kansas City 12, Mo.

"Now, let me show you what Pritchard has done on the inside!"

For coldest climates— Pritchard Type WX Louvers



These sturdy Type WX louvers instantly solve the problem of ice formation even in coldest climates. The wide louvers are supported in a frame set out from the tower. Splashing water can't reach the louvers and form ice.

Each louver is individually hinged. It can be opened or closed to control air flow into the tower. Thus, water temperature and ice formation are controlled, too. You can shut Type WX louvers off on the windward side and leave the louvers on the other side open. And, the entire operation can be accomplished right on the ground. It's safer, more convenient.

Pritchard Louvers—Type C for temperate climates, Type WX for coldest climates—are just one more reason for choosing Pritchard Cooling Towers!

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aligning bearings. Link-Belt Co, Dept PR, Prudential Plaza, Chicago, Ill.

18 **Indexing mechanisms.** Illustrated 24-p catalog 106 contains full selection and application data on high-speed units. Included are methods of calculating load requirements. Ferguson Machine & Tool Co, Box 5841, St Louis 21, Mo.

METERS AND INSTRUMENTS

19 **Oxygen analyzer.** Illustrated 16-p bulletin 55-829-56 explains principle, construction, operation and features of both the paramagnetic-type analyzer and the electronic recorder. The Hays Corp, Michigan City, Ind.

20 **Electric thermostats** for factories and institutions are described in 2-p bulletin 1000B. Also contains data on immersion thermostats for hot-water heating systems, unit heaters and alarm circuits. Sarco Co, Inc, Dept P, Empire State Building, New York 1, N. Y.

21 **Water leak detector.** Illustrated 20-p bulletin 1301 describes unit consisting of pitot rod, manometer and pitot recorder that is used to locate hidden leaks in water mains. Simplex Valve & Meter Co, Lancaster, Pa.

22 **Meter sockets.** Information on round and square die-cast sockets for single-phase and network meters, box-type for standard polyphase, and high-capacity single- and polyphase meters, is contained in 20-p bulletin GEA-5878B. General Electric Co, Schenectady 5, N. Y.

23 **Manometers.** Illustrated 4-p bulletin G-10 sets forth four basic types of manometers ranging from simple U-tube to ultra-precision models and provides principles to aid in proper selection. The Meriam Instrument Co, 11027 Madison Ave, Cleveland 2, Ohio.

PIPING, VALVES, FITTINGS

24 **Machining** stainless steel tubing and pipe is subject of 4-p technical folder TDC-182. Tooling, power requirements, cutting oils and finishing are briefly discussed. The Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

25 **"Transite** mine service pipe with *ring-tite* coupling" is a 12-p bulletin that suggests uses for asbestos cement pipe. Describes how it is made and gives case histories of various installations. Johns-Manville, 22 E 40th St, New York 16, N. Y.

26 **Expansion joints.** Featured in 24-p catalog 153 is a discussion of various types of expansion joints on the market and types of pipeline motion solved by expansion joints. Flexonics Corp, 1301 S 3rd Ave, Maywood, Ill.

(*Continued on page* 228)

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27 Regulating valves. Diaphragm-type and piston-type units that will handle water, steam, air, gas, oil or other similar fluids at unlimited pressures are detailed in 4-p bulletin 1027. Copes-Vulcan Div, Blaw-Knox Co, Erie 4, Pa.

28 **Bronze globe valve,** rated at 200-lb SP, 400-lb WOG, is described in illustrated 2-p circular 605. Lunkenheimer Co, Box 360, Cincinnati 14, Ohio.

PUMPS AND ACCESSORIES

29 **Centrifugal pumps** and valves are subject of 20-p bulletin 1055. Includes photos, dimension drawings, data tables and performance curves. McNally Pittsburg Manufacturing Corp, Pittsburg, Kansas.

30 **End-suction** centrifugal pumps. Illustrated 12-p bulletin 4011-A includes data on units representing different power ends, to which numerous sizes of liquid ends can be attached. Performance tables and curves list characteristics of all possible combinations. The Deming Co, Salem, Ohio.

31 **Technical reprint,** "Fundamentals of controlled volume pumping," describes how controlled volume pumps are used as flow control instruments in both open and closed loop instrumentation systems. Milton Roy Co, Station M, 1300 E Mermaid Lane, Philadelphia 18, Pa.

32 **Canned motor pumps** for high temperatures are described in 4-p bulletin 1040. Contains application data, typical performance curves, full specs. Chempump Corp, Station L, 1300 E Mermaid Lane, Philadelphia 18, Pa.

33 **Turbine pump motors.** Illustrated 16-p bulletin 1903 describes hollow-shaft Verticlosed grease- and oil-lubricated motors in sizes from 1½ to 400 hp, single-phase designs up to 7½ hp and totally-enclosed types to 150 hp. U.S. Electrical Motors Inc, Box 2058, Los Angeles 54, Calif.

MISCELLANEOUS

34 **Pressure vessels** and tanks for the processing industries are detailed in illustrated 48-p bulletin 554. Contains corrosion-data tables for various metals. Nooter Corp, 1400 S 2nd St, St Louis, Mo.

35 **Manlift** for inter-floor transportation is described in illustrated 8-p bulletin 07B6878B. Unit requires less installation space than conventional stairway or ordinary elevator. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

36 **Passenger conveyor** system. Colorful 8-p bulletin includes photos of existing installations as well as basic design and application data. Stephens-Adamson Mfg Co, Aurora, Ill.

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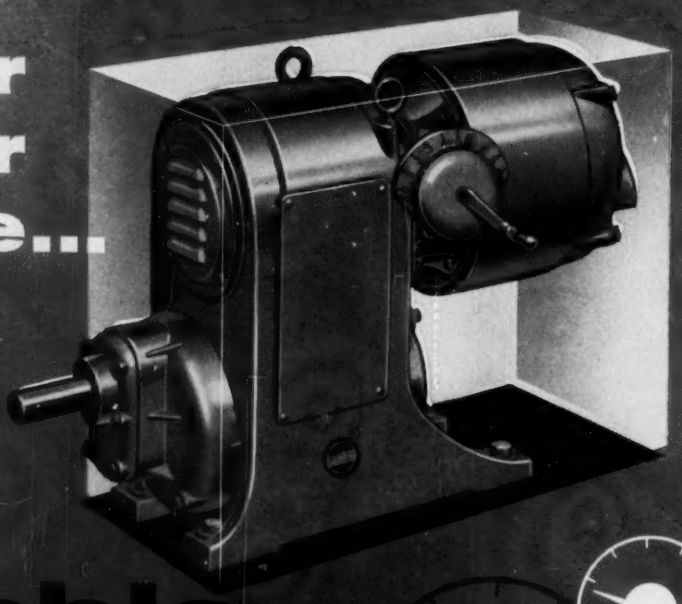

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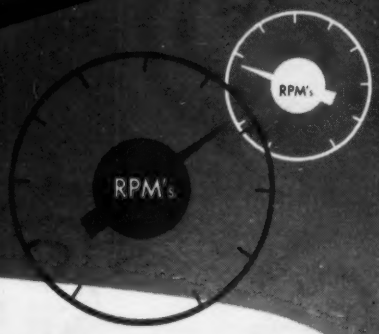

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Begins on page 154

Guiding principles in the thermal evaluation of electrical insulation. *By L J Berberich and T W Dakin, Westinghouse Electric Corp. AIEE paper No. 56-248.*

Trends in electric space heating controls. *By J C Beckett, Wesix Electric Heater Co. AIEE paper No. CP 56-253.*

Research by the Central Electricity Authority. *By J S Forrest, Central Electricity Research Laboratories, Surrey, England. AIEE paper No. CP 56-267.*

Alignment tolerances for vertical hydroelectric generators. *By J J Hart, Westinghouse Electric Corp and J Fisch, S Morgan Co. AIEE paper No. CP 56-275.*

Distribution systems practice in steel plants. *By Basil J Auburn, Auburn & Associates, Inc. AIEE paper No. CP 56-304.*

Proposed guide—maintenance of insulating oil. *By Subcommittee on insulating fluids, AIEE committee on transformers. AIEE paper No. CP 56-358.*

Reactor designs

A two-fluid reactor concept. *By L I Katzin and B I Spinrad, Argonne National Laboratory.*

The concept is presented for a reactor in which the fuel and fertile material are maintained as separate circulating fluids, with the fertile fluid acting as coolant for the fuel fluid, in analogy with a heat exchanger. Relations are established for operating conditions, with the U-233-thorium cycle, which give maximum breeding rate (minimum doubling time) for the fuel material invested. Design for such a reactor, featuring simple unitized construction, will be suggested. Operation under pressure would yield power. The identical machine can be used as a very efficient U-235-U-233 converter, to start the cycle. *NESC paper No. 35.*

An internally cooled liquid metal fuel reactor design. *By R J Teitel, Brookhaven National Laboratory.*

Several new features are described which can be applied to liquid metal fuel reactors. These are intermetallic dispersions of fuel and fertile streams

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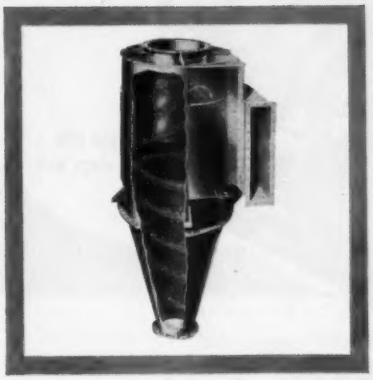

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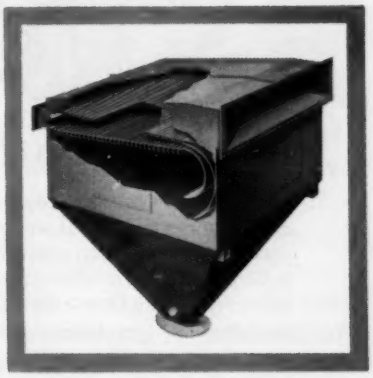

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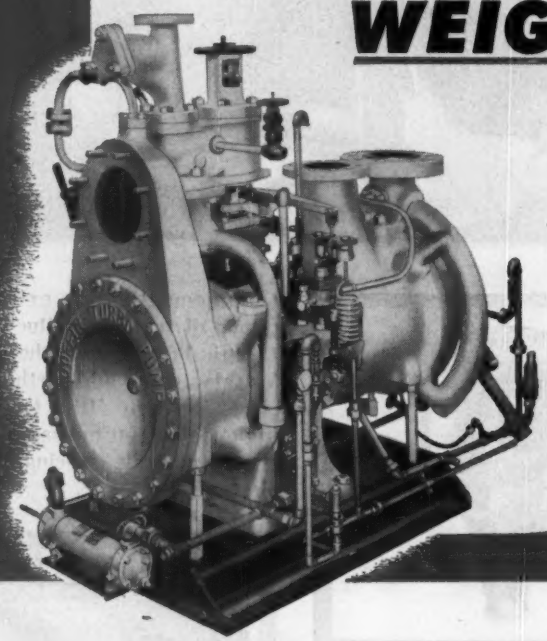

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More TECHNICAL BRIEFS

Begins on page 154

as a core coolant, use of graphite to contain the fuel and fertile stream, "pot-type" construction, and the use of naturally occurring lead of low capture cross section. A preliminary design of a power breeder incorporating these features is given. Values for the size, power, inventory, doubling-time, etc, are calculated and appear to compare favorably with other liquid metal fuel reactor designs. Some procedures for processing the fuel and breeder blanket for removal of their respective radiation products are described. *NESC paper No. 34.*

Power conversion systems for dual-cycle boiling reactor. *By V A Elliott and T Trocki, Knolls Atomic Power Laboratory.*

This paper treats the principal characteristics and thermodynamic performance of various alternative power conversion systems applicable to the dual-cycle boiling-water reactor.

The studies consider, in part, the following: (a) reactor subcooling by flashing recirculating water to steam versus subcooling with heat exchanger in relation to plant heat rate and auxiliary power requirements (b) higher pressures and temperatures versus lower pressures and temperatures in relation to cycle heat rates, equipment sizes, and various fuel types (c) cycles with nonradioactive turbine versus cycles with radioactive turbine (d) separately fired superheating versus no superheating in relation to plant heat rate and capital cost. *NESC paper No. 81.*

Waste disposal

Processing of high level atomic wastes with the view to ultimate disposal. *By L P Hatch and W H Regan Jr, Brookhaven National Laboratory.*

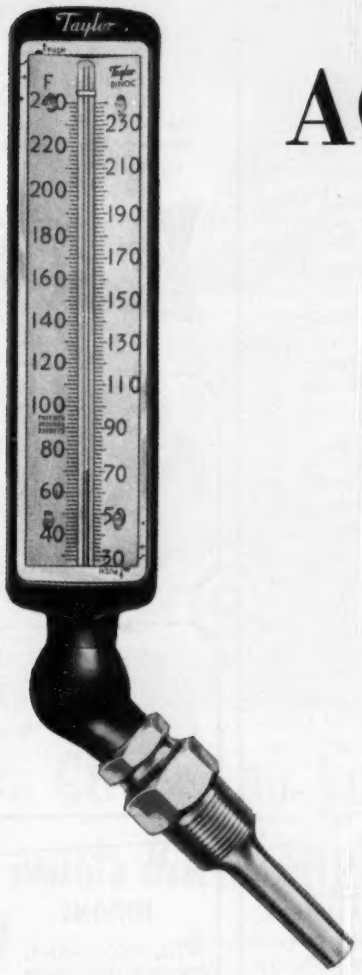
High-level fission-product waste solutions taken directly from the processing of spent uranium fuel elements from atomic reactors usually are not suitable for efficient adsorption of fission products by ion exchange on clay minerals. Separation of the bulk of the nonradioactive ions from the fission products, therefore, is a highly desirable first step. Use of such processes as electrodeionization, high-temperature calcination, and distillation to accomplish such separations are discussed with emphasis on elements of engineering design. *NESC paper No. 175.*

Water-quality problems in nuclear energy development. *By S K Love and W F White, U.S. Geological Survey.*

Measurement of radioactivity of sur-

Directions for ordering papers on p 240

2 ways to measure temperature ACCURATELY



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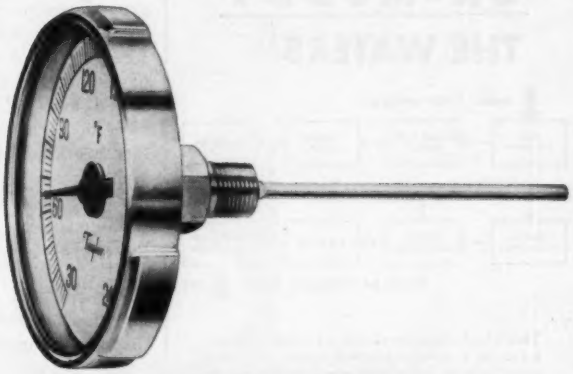

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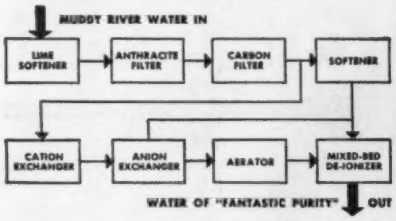

This block diagram shows a typical arrangement for a power company steam plant that must draw its boiler feed water from a nearby muddy river. The Lime Softener takes out suspended solids, turbidity, alkalinity, and organic matter; the Anthracite Filter removes any remaining turbidity; the Carbon Filter removes the chlorine; the Softener provides process water; the Cation and Anion Exchangers remove the dissolved solids such as carbonates, sulfates, and chlorides; the Aerator takes out most of the CO_2; and the Mixed-Bed De-Ionizer eliminates the remaining 4 or 5 ppm of solids, silica, and 5 ppm of CO_2 — to produce water of "fantastic purity."

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More TECHNICAL BRIEFS

Begins on page 154

face and ground waters is affected by the variable environment of the radioactive material. Surface waters are subject to wide differences and often rapid changes both in volume of flow and in concentration of dissolved and suspended materials. These variations result from numerous natural phenomena as well as from irrigation, industrial and domestic usage of the water. Ground waters are more stable with respect to concentration of dissolved material and generally are relatively free of suspended matter. However, ground waters are in more intimate contact with solid material and therefore have more opportunity for solution of minerals and for deposition of dissolved material by geochemical processes or by adsorption. Procedures for measuring radioactivity in water must make proper allowance for these variations in characteristics; otherwise unreliable results will be obtained. *NESC paper No. 179.*

Mixed-bed ion exchange for the removal of radioactivity. *By H Gladys Swope, Argonne National Laboratory.*

Mixed-bed ion exchanger containing high-capacity resins of the polystyrene divinyl benzene sulfonic acid type of cation resins and the quaternary amine type of anion resins will remove radioactivity almost completely. The capacity of such beds for radioactivity removal is inversely proportional to the amount of total solids dissolved in the water.

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The application of mixed-bed ion exchangers for cleaning up water in a reactor and for removal of radioactivity from wastes is discussed. *NESC paper No. 173.*

Ultimate disposal of radioactive reactor wastes in the oceans. *By Charles E Renn, The Johns Hopkins University.*

To the present, limited amounts of low-level laboratory and experimental radioactive wastes have been disposed at sea. These operations provide convenient, local service to laboratories and installations near the coast.

Preliminary studies of the practicability and economics of using the sea for ultimate disposal of massive activities associated with a practical reactor power enconomy show that a careful assessment of specific areas must be

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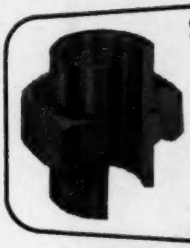

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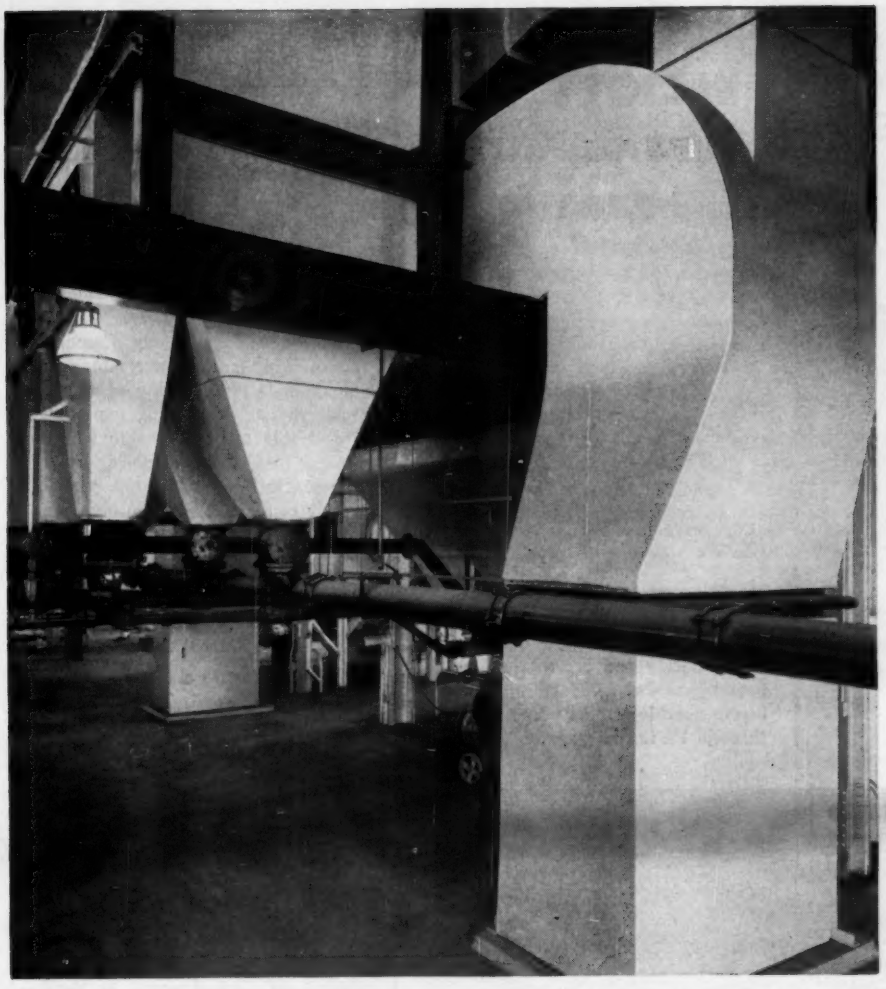

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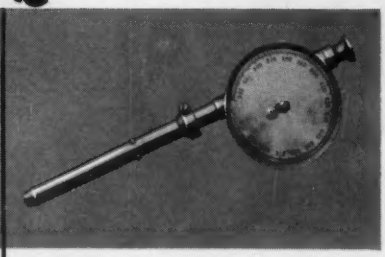

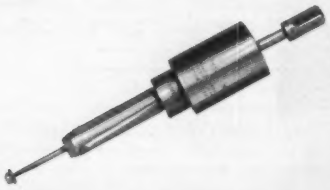

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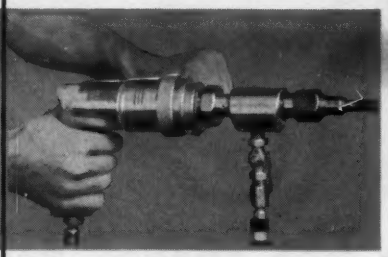

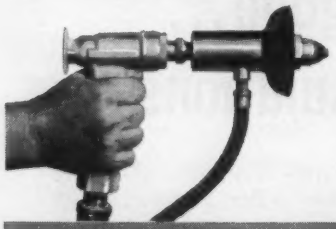

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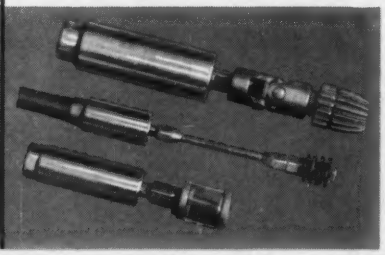

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More TECHNICAL BRIEFS

Begins on page 154

made. There are a number of promising systems that may be exploited, but all require individual restudy and development of critical data before they can be utilized. *NESC paper No. 184.*

Status of land disposal of atomic reactor wastes. *By Arnold B Joseph, The Johns Hopkins University.*

Under Atomic Energy Commission sponsorship, many conceivably practical methods of disposing of high-level reactor wastes are being explored. It is desirable to develop safe and inexpensive means for disposing of such wastes. Such means would contribute greatly to the economic development of atomic power. Long-term storage of wastes in tanks, as presently practiced, is high in cost. Cheaper and more permanent disposal methods under consideration are disposal or storage in deep permeable saline formations; cavities dissolved in salt formations; deep structural troughs; and isolated desert sinks. *NESC paper No. 185.*

Design considerations of storage tanks for radioactive wastes. *By Edgar E Wilson, E I duPont deNemours and Company.*

Basic considerations involved in designing facilities for the long-term storage of radioactive wastes at the Savannah River Plant are presented. Storage facilities initially installed consist of 750,000-gal. 75-ft diameter carbon-steel tanks surrounded by concrete housing forming annuli to permit accumulation, detection and removal of any leakage that might occur. The tanks were built in a pit, water-proofed and covered with earth.

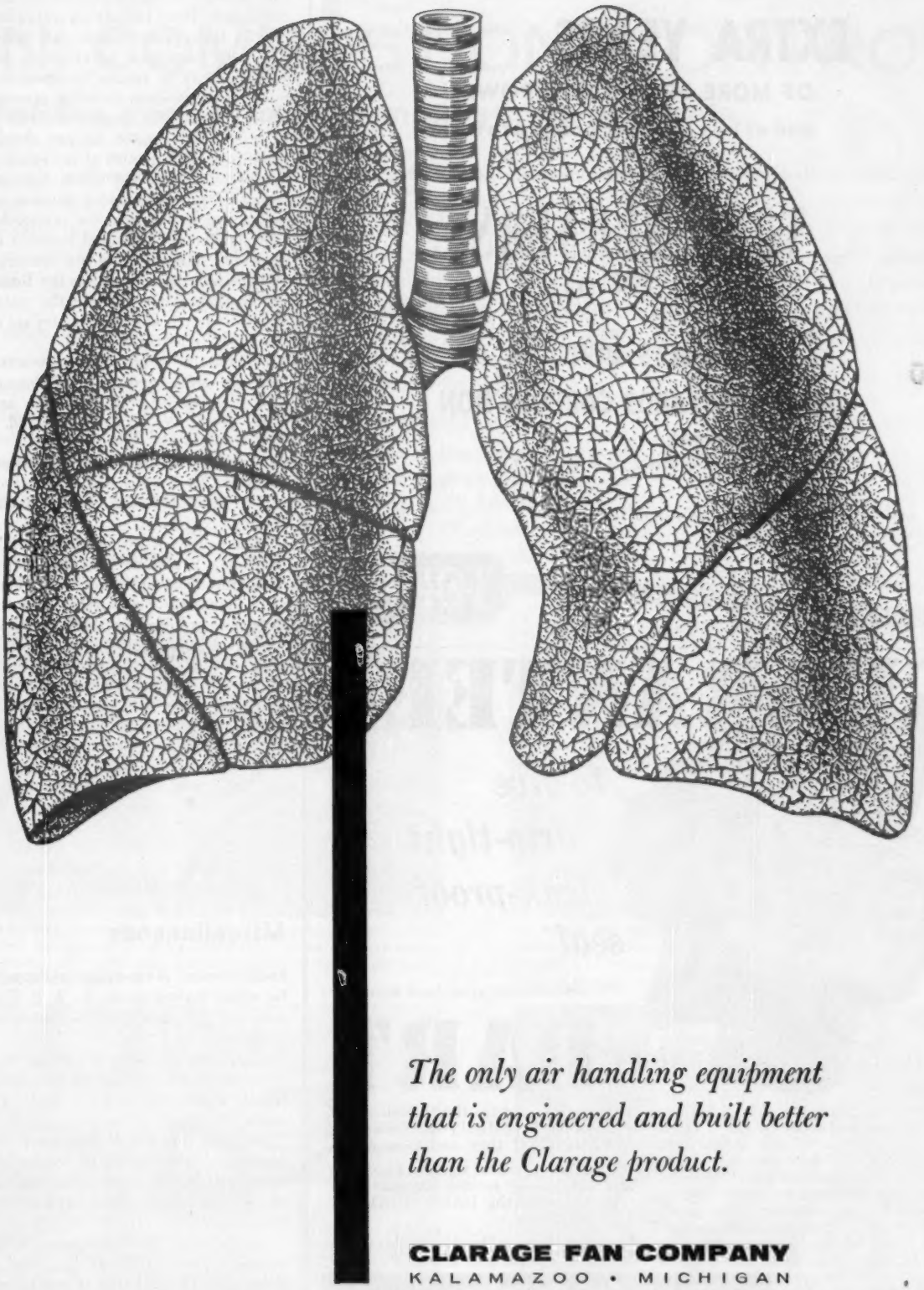
In a subsequent installation the tank size was increased to 1,000,000 gal., but the tops of the concrete housings were located slightly above finished grade and bottoms of the steel tanks at groundwater level. *NESC paper No. 187.*

Disposal of atomic wastes. *By E I Goodman and R A Brightsen, Nuclear Science and Engineering Corp.*

In essence this paper is a survey of the literature on waste disposal and a commentary on its significance.

The dispersal, controlled-containment and partially controlled-containment approaches are discussed. Ultimate disposal based on sound conservation principles is advocated. Limits of dispersal and partially controlled containment are stated. Dependence of waste-disposal methods on reactor design and fuel processing is emphasized. Type

Directions for ordering papers on p 240



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More TECHNICAL BRIEFS

Begins on page 154

and sources of radioactive wastes are delineated. These include natural radioactivity from processing of raw materials and fabrication of elements, induced activity in reactor coolants and fission products from chemical processing of reactor fuels. Improved chemical processes and reactor designs should result in large reduction of the volumes involved. LMFR and HRE are approaches to these reduced volumes of radioactive wastes from the reactor-design standpoint. Improved methods of processing nuclear fuels are the crux of the whole problem since the liquid wastes from processing are the major wastes—gaseous and solid wastes are of secondary importance.

Estimates of future radioactive waste loads are given from the predictions of future nuclear reactor operations and power needs. *NESC paper No. 188.*

Radioactivity as a factor in stream pollution. *By R C Palange, G G Robeck and C Henderson, U.S. Public Health Service.*

Manufacture of fissionable materials, increasing peacetime uses for atomic energy products and projected development of nuclear power facilities introduce new problems in the field of environment sanitation. One of these problems, of direct concern to many state and local health departments and to others, is the possibility of contamination of surface streams.

The paper discusses effects of low-level radioactive effluents on the physical, chemical, and biological characteristics of surface waters, based on studies made by the Public Health Service. Also discussed are techniques used to define and approach this type of problem. *NESC paper No. 190.*

Miscellaneous

Radiochemical plant-design philosophy for direct maintenance. *By K K Kennedy and D C Reid, Phillips Petroleum Company.*

Major considerations for design of a direct maintenance plant for processing highly radioactive reactor fuels are given.

Emphasis is placed on totally enclosed equipment, a minimum of mechanical equipment in radioactive areas and use of commercially available and proved equipment.

Feasibility of direct maintenance has been well proved at the Idaho Chemical Processing Plant. Feeds containing up to 150 curies of activity/liter have been

Directions for ordering papers on p 240

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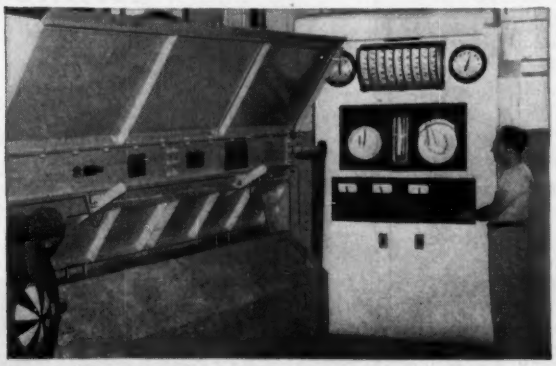
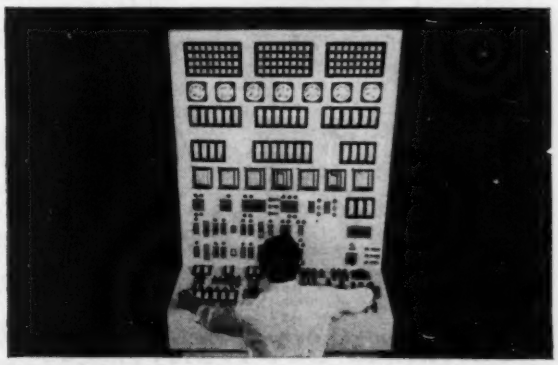
At Morton Salt Company, Manistee, Michigan, the fact that electricity doesn't freeze is vital in this semi-outdoor boiler which handles load swings up to 80,000 lb/hr at 85% efficiency with help of Hays electrically operated combustion control system.



At Falstaff Brewing Corporation, modernization and Hays metering type control have resulted in boiler efficiency of 82%, fuel cost reduction of several hundred dollars per month, CO_2 up from 6% to 12%, and maintenance costs lowered 65%.



At Louisiana Power and Light, a compact Hays B. T. G. control panel only 4 feet wide controls a giant 1,000,000 lb/hr boiler, turbine and generator! Instrumentation and control by Hays includes electronic mercuryless flow meters and other electronic instruments.

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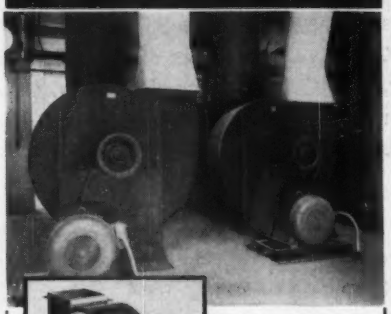

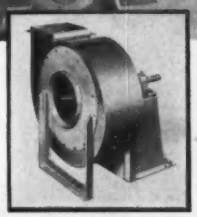

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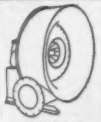

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More TECHNICAL BRIEFS

Begins on page 154

processed with subsequent decontamination sufficient to permit 8-hours a day working time in the "hot" cells. Operating costs have been lower than anticipated, with approximately 98% on stream operating efficiency. *NESC paper No. 312.*

Application of radioactive tracers to engine research. *By A Hundere, G C Lawrason and J P O'Meara, Southwest Research Institute.*

This paper presents a general review of the application of radioactive tracers to engine research. Activation of parts, safety precautions, instrumentation and test procedures are discussed. Radioactive piston-ring-wear data are presented for three different applications and engines—the determination of corrosive wear under low-temperature conditions, the determination of load-carrying ability by measuring wear as a function of load under high-temperature conditions and the determination of the effect of dust content on ring wear. Also presented is the application of the technique for determining gear wear and the rating of lubricants on a comparative basis. It is concluded that the radioactive tracer technique can be easily and safely utilized for wear studies and that it is a powerful tool for increasing our knowledge of wear. *NESC paper No. 161.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Power Conference, 18th annual meeting. Identified by initials APC and obtainable through purchase from Director, APC, Illinois Institute of Technology, Chicago 16, Ill.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

Papers identified by initials NESC, Nuclear Engineering and Science Congress, are obtainable at 30c each from the American Society of Chemical Engineers, 25 W 45th St, New York 36, N. Y.

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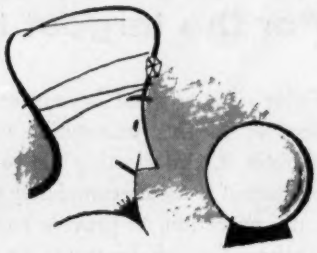

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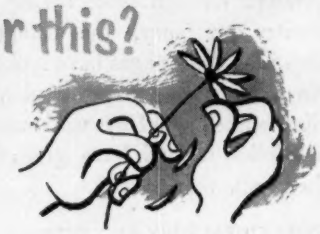

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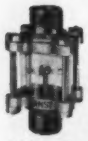

FIG. 29 Cylinder with Impeller

FIG. 17-28 Cylinder

FIG. 215 Flanged

FIG. E-57 Double Window

FIG. 212 Visibility Welding Neck or Screw

FIG. E-811 Flapper

FIG. E-1810 Rotating Wheel Type

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REPORTS from the FIELD

Begins on page 152

Pell W Foster Jr announces opening of consulting office

► PELL W FOSTER JR, retired vice-president of the Foster Wheeler Corp, has opened an independent management-consultant office at 171 Chestnut St, Englewood, N. J. He will specialize in service to manufacturers of power equipment.

At the time of his retirement from Foster Wheeler in 1955, he was vice-president in charge of the combined activities division which included the engineering, construction, personnel, purchasing, legal, research and development and office management departments. In 1952 he served as president of the American Boiler Manufacturers Association.

Calendar of Events

May 9-11—American Welding Society, National Spring Meeting and fourth Welding Show. Memorial Auditorium and Hotel Statler, Buffalo, N. Y. Details from AWS, 33 W 39th St, New York 18, N. Y.

May 14-17—American Society of Mechanical Engineers, Design Engineering Conference to be held at same time and place as the first Design Engineering Show (an industrial exposition produced by Clapp & Poliak, Inc, New York). Convention Hall, Philadelphia, Pa. Details from ASME, 29 W 39th St, New York, N. Y.

May 15-16—Industrial Nuclear Technology Conference, sponsored jointly by Nucleonics magazine and Armour Research Foundation of Illinois Institute of Technology. Museum of Science and Industry, Chicago, Ill. Details from INT Conference, Armour Research Foundation, 10 W 35th St, Chicago 16, Ill.

May 16-18—Society for Experimental Stress Analysis, William Penn Hotel, Pittsburgh, Pa. For details write Dr W M Murray, SESA, P.O. Box 168, Cambridge 38, Mass.

May 17-19—New York State Society of Professional Engineers, 30th Engineering Industries Exposition and Annual Convention. Hotel Statler, New York City. Details from Mr George Baer, chairman, c/o Foster-Wheeler Corp, 165 Broadway, New York, N. Y.

May 21-24—Air Pollution Control Association, Niagara Frontier Annual Meeting, Buffalo, N. Y. Details from APCA, 4400 5th Ave, Pittsburgh 13, Pa.

June 4-7—National District Heating Association, 47th Annual Meeting. Wil-

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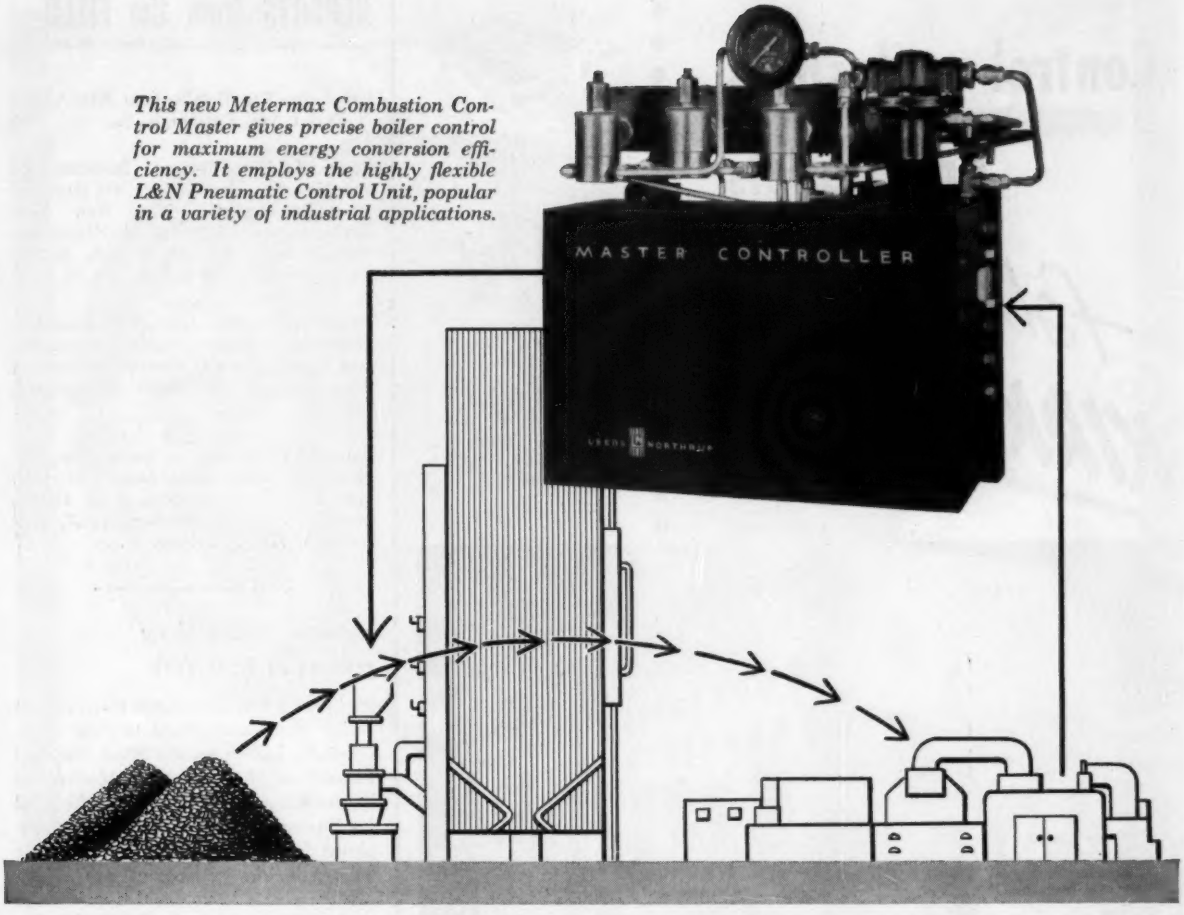

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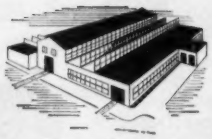

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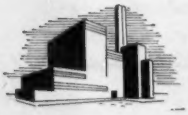
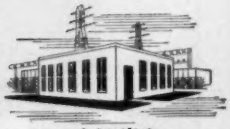
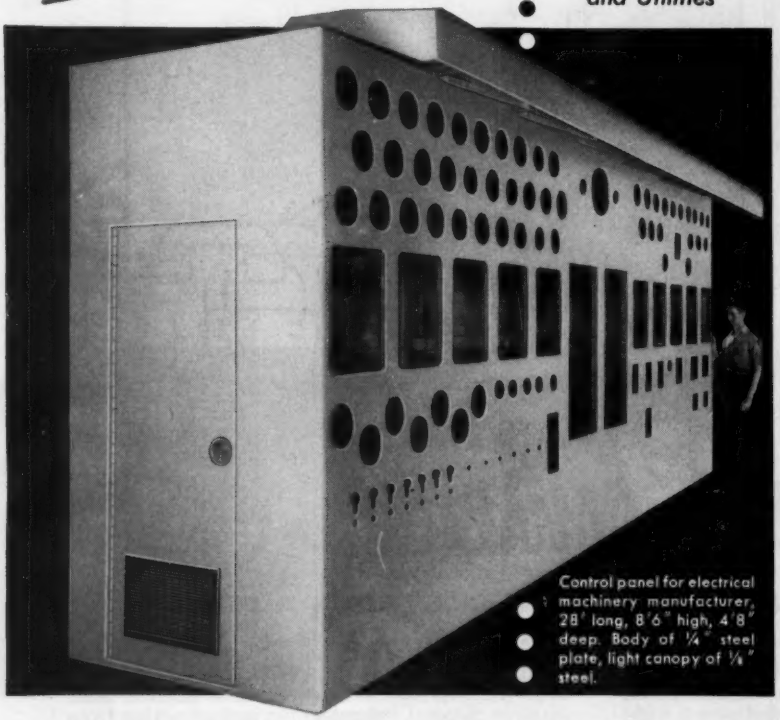


Power Plants



and Utilities



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METAL FABRICATION

REPORTS from the FIELD

Begins on page 152

liamsburg, Va. Details from NDHA, 827 N Euclid Ave, Pittsburgh, Pa.

June 11-15—Oil-Heat Institute of America, Inc, 21st National Oil Heat and Airconditioning Exposition, New York Coliseum and 34th Annual Convention, Park Sheraton Hotel, New York. Details from OHI, 500 5th Ave, New York 36, N.Y.

June 18-22—4th Annual Human Engineering Institute, Stamford, Conn. Details from Dr Leon L Thomas, Dunlap and Associates, Inc, 429 Atlantic St, Stamford, Conn.

June 25-29—American Society for Engineering Education, Annual Meeting. Iowa State College, Ames, Iowa. Details from W L Collins, secretary, ASEE, University of Illinois, Urbana, Ill.

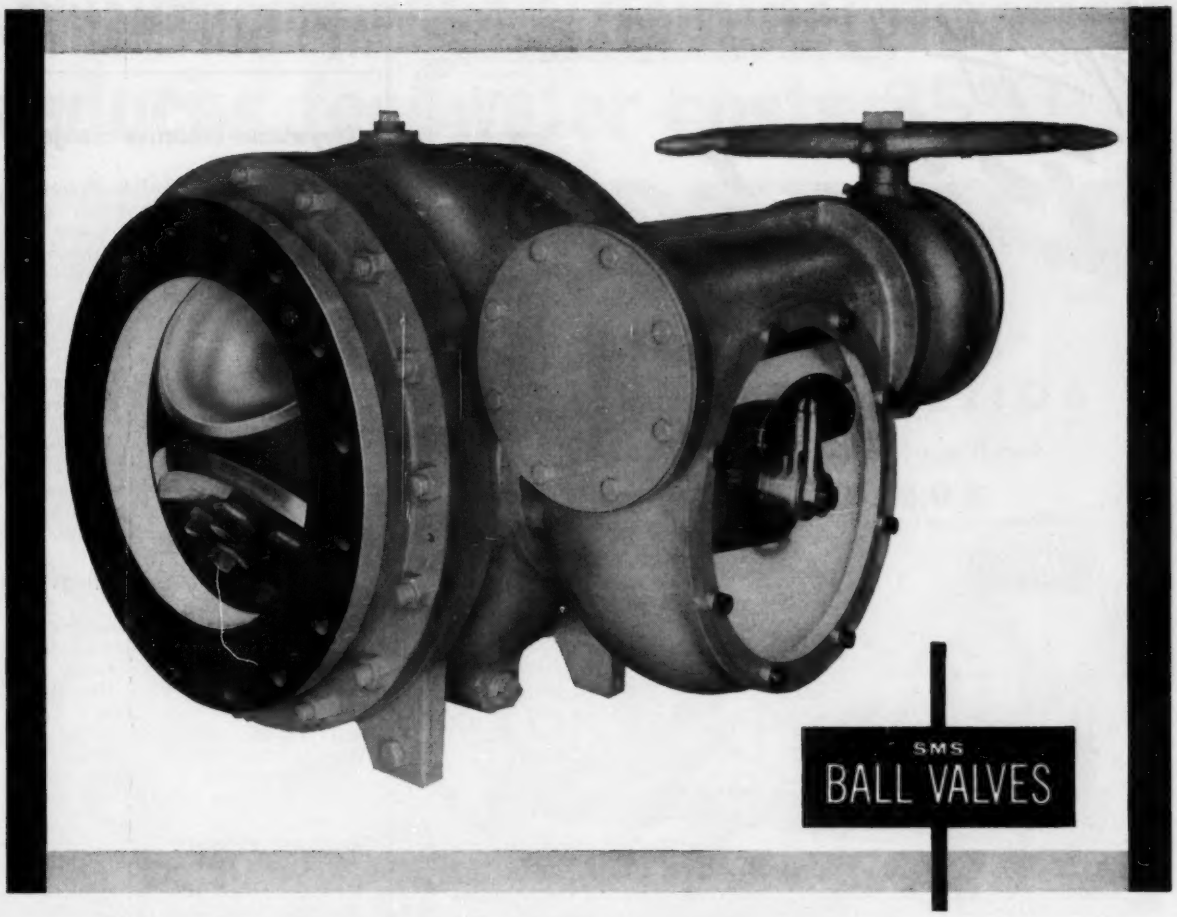
National Power Show returns to New York

► AFTER A 4-YEAR ABSENCE the National Power Show will return to New York. Officially known as the 22nd National Exposition of Power and Mechanical Engineering, the display is scheduled for November 26-30 at the recently completed New York Coliseum. It will be held under the auspices of The American Society of Mechanical Engineers in conjunction with the Society's 76th Annual Meeting. As heretofore, it will be under the management of the International Exposition Company.

Nearly 200 companies have already engaged space. Displays will feature the newest equipment in the power field and mechanical engineering applications. Featured will be an enlarged atomic power section which will include displays by many pioneering companies. Supporting these tangible evidences of progress in nuclear engineering will be the technical sessions of the ASME Nuclear Engineering Division, as well as the National Industrial Conference Board's 5th Annual "Atomic Energy in Industry" conference.

Benjamin Foster Co has developed a new fire-resistant mastic that is said to be nonflammable in the wet state and stops smoldering within seven seconds after removal of a violent kerosene flame. Known as fire-resistant mastic *60-60N*, it is a combination of non-asphaltic fibrated polymers in non-flammable solvents. Company says it is the only mastic coating of its kind accepted by Underwriters' Laboratories for fire-resistant listing.

The firm of Seelye Stevenson Value & Knecht has made Samuel C Bast, supervising structural engineer, an associate.



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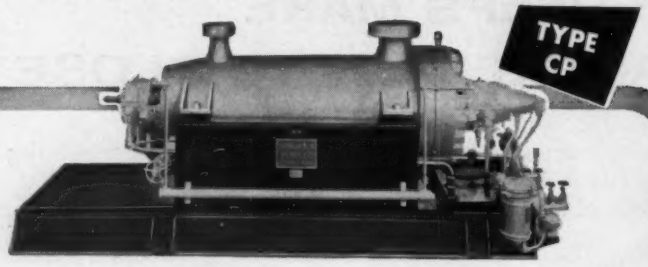

Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham
SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

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Houston, Texas	St. Louis, Mo.
Kansas City, Mo.	St. Paul, Minn.
Los Angeles, Calif.	Tulsa, Okla.
New Orleans, La.	Toronto, Ont., Can.
Vancouver, B. C., Canada	

APPOINTMENTS

Corporation executive changes

A M Byers Co: J Frederic Byers Jr, president. **A M Lockett & Co, Ltd:** George R Hammett and Robert P Lockett Jr, vice-presidents. **Formsprag Co:** Charles F Trapp Jr, vice-president, sales; L T Szady, vice-president, engineering. **Darling Valve & Manufacturing Co:** Carl H Simon, vice-president and general manager.

Link-Belt Co: Richard E Whinrey, vice - president. **McKiernan - Terry Corp:** Herbert G Dillon and George W Bartlett, vice - presidents. **Conveyor Systems, Inc:** Robert M Pfaff, vice-president. **Washington Water Power Co:** Marshall L Blair, Kimball I Jack and W L Thrailkill, vice-presidents.

Operations executive changes

General Electric Co: George White, general manager of atomic power equipment dept. **Elliott Co:** H A Erb, works manager of steam division. **The New York Air Brake Co:** Robert B Taggart, manager of manufacturing at Aurora Pump division. **Federal Pacific Electric Co:** Paul Hafer, superintendent of Great Lakes regional plant.

Engineer changes

Darling Valve & Manufacturing Co: Thomas C Jester, chief engineer. **Diamond Power Specialty Corp:** John A Rado, chief engineer, electronics dept. **Carrier Corp:** Robert C White, chief product specialist, machinery and systems division. **Western Precipitation Corp:** H B Alford, chief field engineer. **The New York Air Brake Co:** Richard H Marvin, chief engineer, Watertown hydraulic equipment section.

Retirements

Stanley Stokes, vice-president of Union Electric Co, after almost 44 years of service.

Mathew Keck, vice-president of Borg-Warner Corp, after 36 years of service.

W D Kirkpatrick, vice-president and sales manager of American Chain division, American Cable Co, Inc, after more than 41 years of service.

Marshall N Stickel, sales representative for Lunkenheimer Co, after 32 years of service.

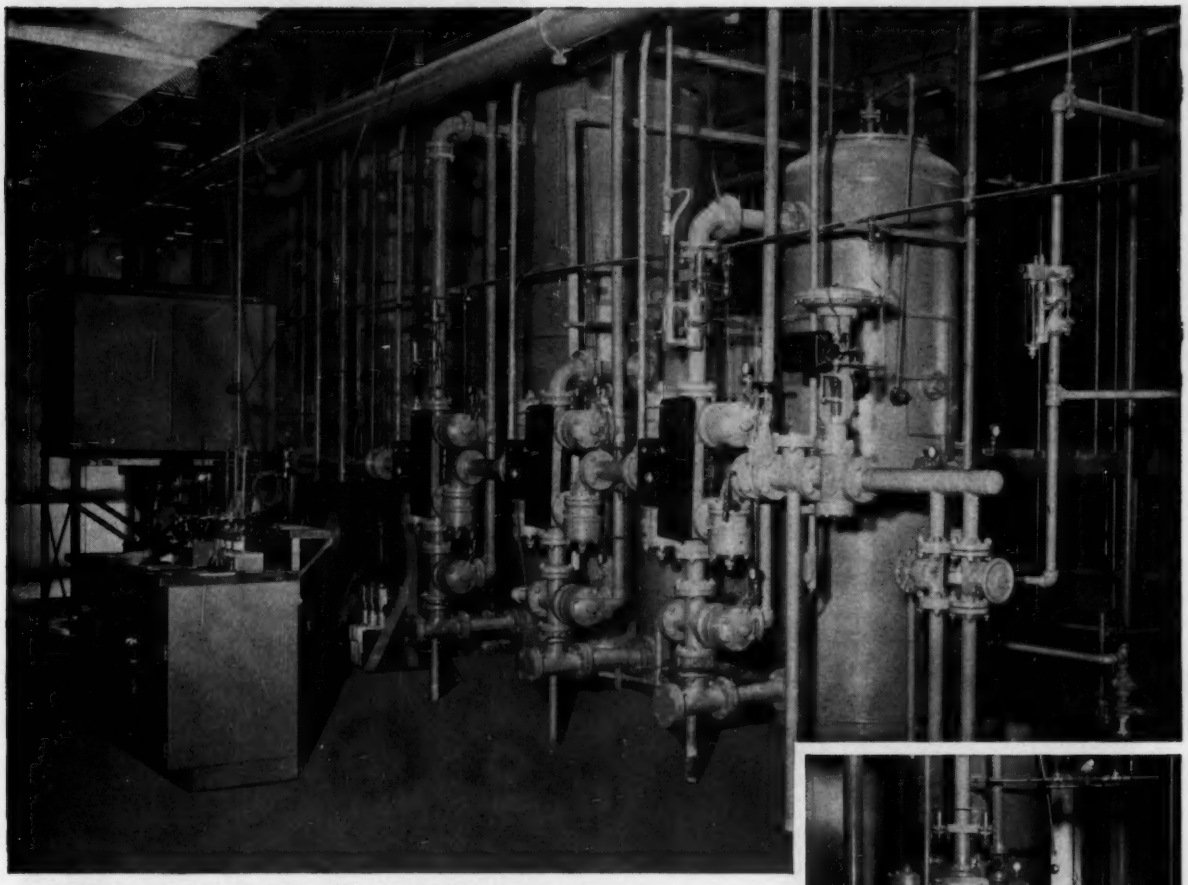
Obituaries

T E Woodruff, manager of pump sales division, Fairbanks, Morse & Co, on February 26th.

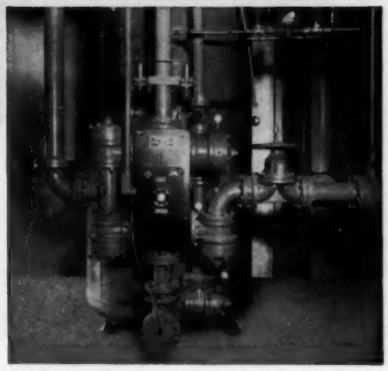
Frank H Merrill, retired executive vice-president of Simplet Electric Co, on February 4th.

Eugene C Crittenden, 75, retired associate director of the National Bureau of Standards, on March 28th.

INFILCO improved demineralization reduces feedwater costs 35%!



INFILCO Demineralization Plant installed at the North Omaha Station.



Close-up of "CATEXER" ion exchange unit.

Here's how it was done at Omaha –

Omaha Public Power District's source of feedwater make-up for 1500 p.s.i. boilers is the Missouri River. This water has high and extremely variable mineral content. Their previous experiences with two-bed demineralization plants indicated that the average chemical cost per 1,000 gallons of treated water would be approximately 40¢.

In considering the water treating requirements of the new North Omaha Station, INFILCO Engineers suggested a new type, four-bed demineralization plant. This suggestion was accepted and actual operations have shown the chemical costs have averaged 26¢ per 1,000 gallons—a saving of 14¢ over the original estimates. In addition, this *fully-automatic* plant initiates regeneration when required, regardless of variations in raw water mineral content, without sacrificing treated water quality.

If you have a high pressure boiler feedwater problem, CATEXER® ANEXER® Demineralization Plants are sure to offer an economical solution. Write for information or see your Consulting Engineer.

INFILCO INC. 917 South Campbell Ave., Tucson, Arizona
Field offices in principal cities in North America 5525

INFILCO

The one company offering engineered equipment for all types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

SOLA FLEX®

installation for Southern California Edison Company

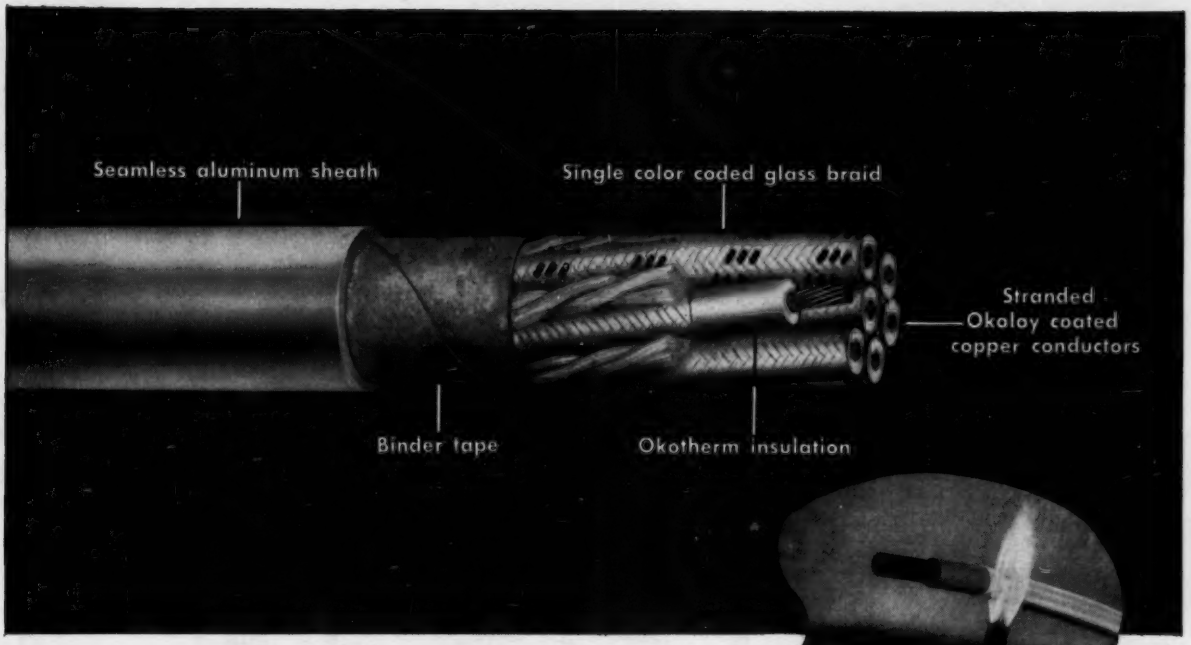
Heavy-duty, Sola-Flex expansion joints are shown in this photo while being installed in the new power plant at El Segundo. These and other Sola-Flex bellows will dependably absorb thermal growth on the steam-traced heavy oil fuel lines.

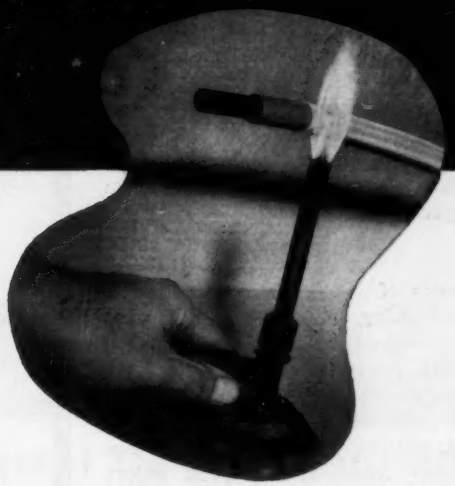
Based on advanced engineering designs, Sola-Flex joints meet every piping problem. Solar builds both convoluted and U-span bellows for low and high pressure service to absorb axial, lateral or offset movement. Sola-Flex bellows are available in a wide range of standard and special sizes from one-half inch up to the world's largest—more than 25 feet in diameter. Send for Sola-Flex catalogs. Address Solar Aircraft Company, Dept. C-16, 2200 Pacific Highway, San Diego 12, California.

SOLAR AIRCRAFT COMPANY

SAN DIEGO
DES MOINES

DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS • GAS TURBINES • BELLOWS • CONTROLS • HIGH TEMPERATURE COATINGS • AIRCRAFT COMPONENTS





lick temperatures up to 392° F and eliminate conduit with OKOTHERM aluminum-sheathed cable

Heat and flame resistance. Direct flame on the individual conductors will not cause circuit failure.

Eliminate conduit and pulling problems. This small diameter, light-weight construction can be bent to a radius of 6 times the cable O.D. with standard conduit tools. It reduces installation costs, and provides a compact, neat construction for congested areas.

Moisture-proof installation. Even without its watertight seamless aluminum sheath, Okotherm insulation itself has excellent moisture resistance.

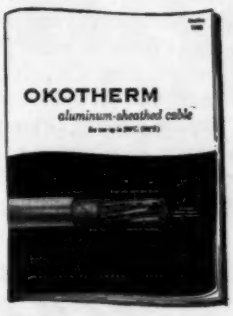
Standard fittings available. Moisture- and heat-proof connectors are available through Thomas & Betts Company distributors.

Use regular installation methods. Okotherm-insulated conductors are handled just like familiar, rubber-insulated wire. The individual conductors can be readily fanned out, trained and terminated.

Resists corrosion. Corrosive gases, aromatic solvents and many other chemical products do not harm the aluminum sheath.

Range of design. #19 Awg through #4/0 Awg stranded, up to 61 conductors depending on their size, can be supplied with seamless aluminum sheath. Present manufacturing facilities permit lengths up to 500'.

Okotherm insulation, compounded from silicone rubber, is a thermosetting material with an eight year successful service record. It is especially useful in power plants, steel mills, pulp and paper mills, oil refineries, petrochemical applications. For additional detailed information, write for Bulletin PW-1088 to The Okonite Company, Passaic, New Jersey.



OKONITE SINCE 1878 *insulated cables*

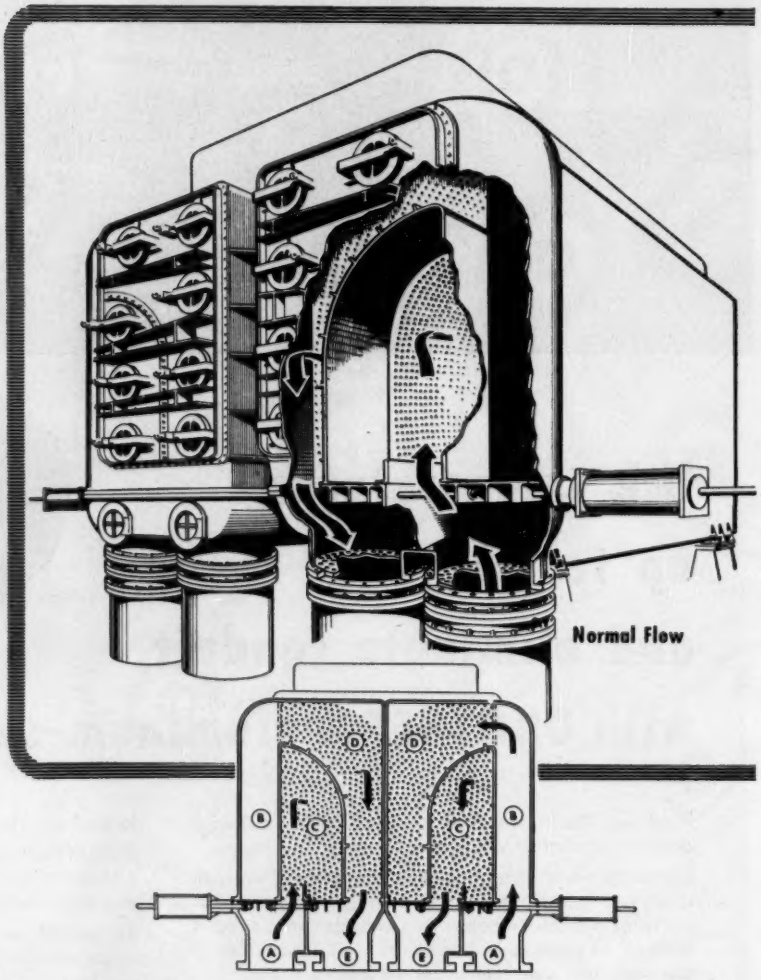
3169

REVERSE FLOW by C. H. WHEELER
Cleans Steam Condenser Tube Sheets Without Loss of Load

When debris and organic growth collect on the tube sheets of a C. H. Wheeler Patented Reverse Flow Steam Condenser, you don't have to shut it down for cleaning. It cleans itself—without loss of load. Sluice gates arranged within the condenser may be controlled, either electrically or hydraulically, to reverse the flow of cooling water through the tubes. This sudden reverse flow literally flushes away leaves and debris, dislodges crustaceous matter from clogged tubes.

Because of 100% water flow during back flushing, there is only a negligible dip in vacuum momentarily, thus permitting continuous load on the turbine The Reverse Flow Condenser cleans itself in minutes, compared with hours of downtime when tube sheets are manually cleaned. A typical report shows a half-inch loss of vacuum (due to fouled tubes and tube sheets) was restored in five minutes after reversing the flow of cooling water. Often, a C. H. Wheeler Reverse Flow Condenser goes two years or more without shut down for cleaning, depending on the condition of the cooling water.

New, exclusive deaerating features and construction techniques help make C. H. Wheeler Steam Condensers "First in Efficiency." Let C. H. Wheeler Custom Engineer your next steam condenser. Phone or write C. H. Wheeler Manufacturing Co., 19th & Lehigh, Philadelphia 32, Pa. . . . Manufacturers of Steam Power Plant Condensers • Vacuum Equipment • Marine Auxiliary Machinery • Water Supply, Drainage and Circulating Pumps.



HOW "REVERSE FLOW" WORKS

Left Side Shows Normal Operation

Water enters inlet A with right port open. Flows through tube bank C to rear of condenser . . . returns through tube bank D to front of condenser and discharges at E.

Right Side Shows Reverse Flow

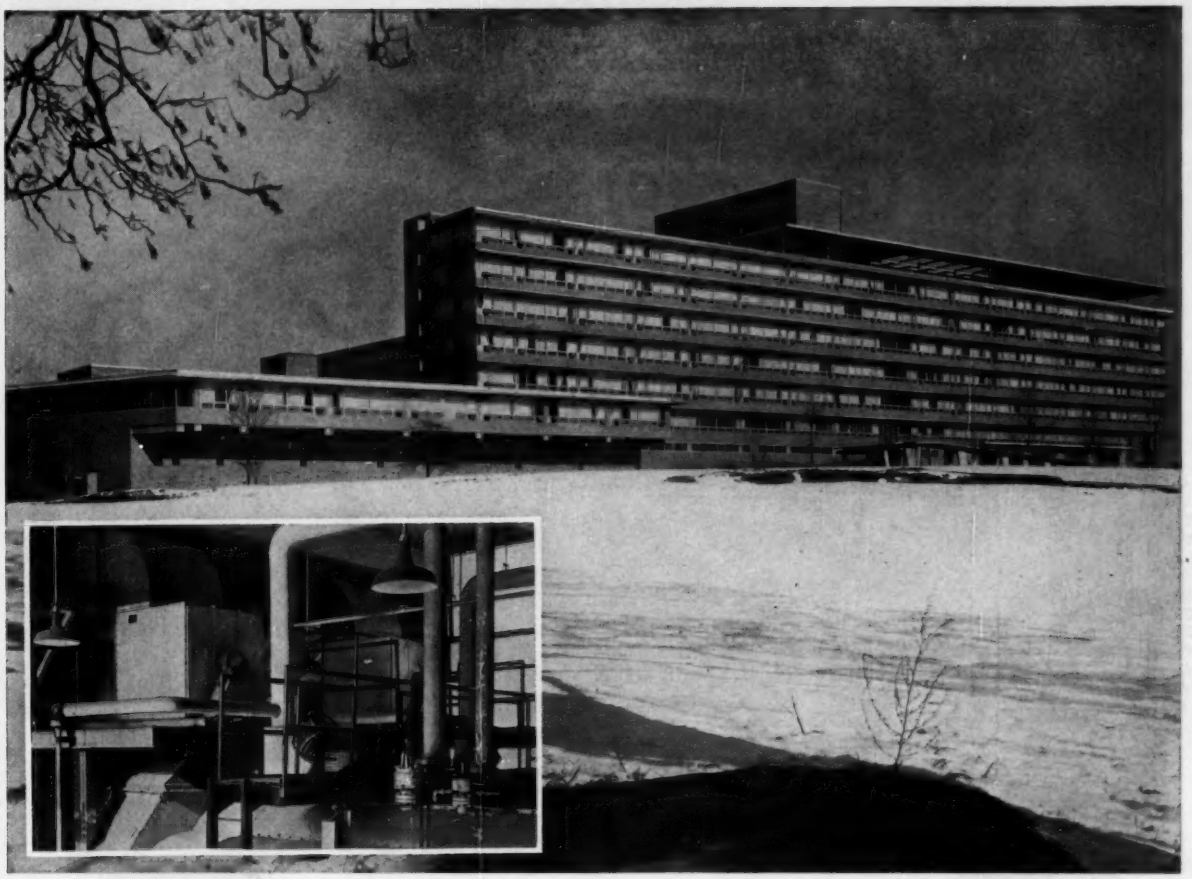
Sluice gates move on a common stem. Water flows up through channel B, and through tube bank D to rear of condenser . . . returns through tube bank C to front of condenser.

In the C. H. Wheeler Divided Water Box Design, each half of the condenser can be back-flushed independently.

WE603

C.H. Wheeler OF PHILADELPHIA

Vincent G. Kling, Architect | A. Ernest D'Ambly, Mechanical Engineer | W. M. Anderson Company, Mechanical Contractors

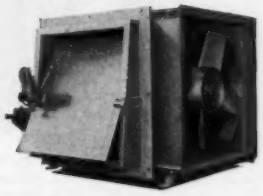


The Last Word in Modern Hospital Design Naturally Uses the Last Word in Mechanical Draft

THE LANKENAU HOSPITAL, in the suburbs of Philadelphia, is one of the world's most modern hospitals, both in architecture and equipment. The hospital itself was established in Philadelphia in the mid-nineteenth century, and has a distinguished history. It moved to its new building in 1953. In specifying equipment, its designers selected the most modern, the most efficient, the most scientific that could be found.

When it came to draft inducers for the boiler plant, they naturally selected Wing, which fulfill all those requirements, and in addition have back of them a lineage almost as old as Lankenau's own.

Wing Draft Inducers cut capital cost through elimination of high stacks, reduce maintenance costs, and result in sizeable fuel savings. They provide positive, adequate, uniform draft for boilers or furnaces entirely independent of weather conditions. And they save money through higher fuel-burning efficiencies. You should learn more about them. Write for Bulletin I-56.



Wing

DRAFT INDUCERS

L. J. Wing Mfg. Co. 50 Vreeland Mills Rd., Linden, N.J.
Factories: Linden, N.J. and Montreal, Canada

WING REVOLVING HEATERS

WING FRESH AIR SUPPLY HEATERS

WING BLOWERS

WING TURBINES

Mail the coupon for bulletin

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Please send copy of Draft Inducer Bulletin I-56.
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Tapered for positive suspension.
High radial sealing surface.
"Tongue and groove" for easy installation.
Clearance for radial motion.

KOPPERS HUHN CARBON RING

Reduces Steam Loss as much as 90%!

The unique design of Koppers Huhn Carbon Ring reduces steam loss far below the customary 1% loss of labyrinths and carbon garter spring rings. Huhn Carbon Ring keeps steam loss as low as ¼ of 1% . . . often as little as 1/10 of 1%. Using your own figures for steam costs, you can easily discover how much Koppers Huhn Carbon Rings can save you annually.

The design assures you continuous radial sealing . . . because a radial sealing surface is always forced against a chamber wall. Automatic suspension . . . even during shutdowns . . . prevents shaft contact, reduces wear, and prolongs life. The Huhn Carbon Ring operates with peak efficiency at highest shaft surface speeds and highest operating temperatures.

Koppers Huhn Carbon Ring replaces labyrinths and carbon garter spring rings in compressors, and steam and water turbines. Steam savings alone often pay within a year for the cost of replacement. Discover now how Huhn Carbon Rings reduce steam and fluid losses and minimize operating, maintenance and repair costs. Write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 2105 Hamburg St., Baltimore 3, Md.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS®

MECHANICAL SHAFT SEALS

Archbishop Thos. J. Walsh Homes. 13 buildings; 630 units.

Rev. William P. Hayes Homes. 11 buildings; 1458 units.

Otto E. Kertchner Homes. 8 buildings; 730 units.

Thousands of MARSH Valves and Traps for this big Newark project!

A bright spot in the dark clouds that overhang Humanity is America's big drive to solve the housing problems of congested cities.

The development pictured here is in Newark. It consists of four projects, comprising a total of 41 big buildings containing more than 20,000 rooms. The four developments provide about five rooms each for over 4,000 families—enough dwelling units to house the entire population of a city of nearly 20,000 people.

Naturally, in buildings like these it is necessary for the sake of initial economy to rule out frills and embellishments. But never forget that the vital need for long-range economy dictates *highest quality in every basic element of construction.*

That is why only the best heating equipment is used in the four big central heating systems. That is why the systems are equipped throughout with thousands of Marsh Radiator Valves and Traps—the kind that will stand up across the years.

Yes, in buildings of every size and kind you will find Marsh Valves, Traps and Vents . . . selected by men who know the economy of using only the best. Let the Marsh man work with you on your next job.

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation, Dept. F. Skokie, Ill.*

Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd St., Edmonton, Alberta

Newark's big scale housing

The four projects—three of them completed and fully tenanted—provide homes for 4,374 families in the 20,681 rooms of 18 12-story; 13 8-story, 1 7-story, and 5 3-story buildings. The project is described as:

Housing Authority,
City of Newark, N. J.
David Kent — Dir. of Development
Louis Danzig — Exec. Dir.
Steve Galaida — Mechanical Engineer

The projects are:

1. Otto E. Kertchner Homes
   General Contractor: HRH Construction Co., New York, N. Y.
   Heating Contractor: John H. Joyce, Newark, N. J.
2. Archbishop Thos. J. Walsh Homes
   General Contractor: Terminal Construction Co., Wood Ridge, N. J.
   Heating Contractor: John Cooney, Harrison, N. J.
3. Rev. William P. Hayes Homes
   General Contractor: Terminal Construction Co., Wood Ridge, N. J.
   Heating Contractor: Paramount Plbg. & Htg. Corp., New York, N. Y.
4. Christopher Columbus Homes
   General Contractor: Terminal Construction Co., Wood Ridge, N. J.
   Heating Contractor: Paramount Plbg. & Htg. Corp., New York, N. Y.

The Christopher Columbus group of 8 12-story buildings is not illustrated, but is now completed.

The great combination: Marsh packless—*truly packless*—radiator valve and the trouble-free Marsh thermostatic trap.

The Marsh float and thermostatic trap. There is a Marsh trap for every heating service.

MARSH *Quality Heating Specialties* **SINCE 1865**

EAGLE-PICHER
SUPER "66"
INSULATING CEMENT

AND BECAUSE IT STICKS IT—

- Saves time! Applies quickly to any equipment, cold or heated to 1800 F.
- Saves money! Provides far greater coverage and more efficient insulation.
- Gives maximum fuel savings! Unique "springy ball" structure of small, resilient pellets of mineral wool, has thousands of dead air cells.
- Makes difficult jobs easy! Can be used on irregular shapes where application of other insulations is often impossible. Usually requires no reinforcing on applications up to 1½ inches thick.
- Prevents rust! Super "66" contains a special rust inhibitive that actually prevents corrosion.

FREE SAMPLE! WRITE TODAY!
See how Super "66" *really sticks* for easy application wherever insulation is needed!

(Member of Industrial Mineral Fiber Institute)

Since 1843

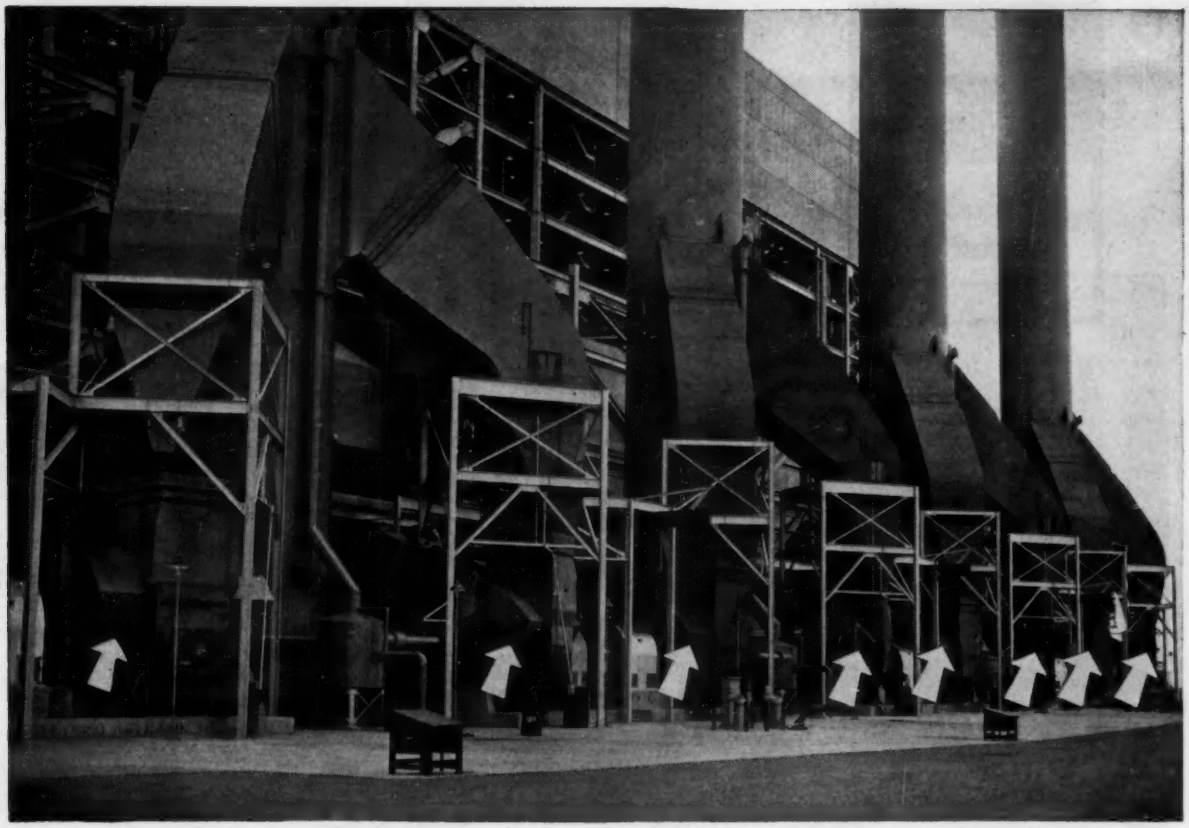
EAGLE EP PICHER

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

PRODUCING A COMPLETE LINE OF INDUSTRIAL INSULATIONS

(Conforms to Commercial Standard CS 117)



Pacific Gas & Electric Company's Pittsburg (California) Station

New Pacific Gas & Electric's Pittsburg Station . . . 660,000 KW . . . Uses 16 Westinghouse Mechanical Draft Fans

Largest Steam Plant in West Uses Westinghouse Fans for Induced and Forced Draft

Here, eight Forced Draft and eight Induced Draft Westinghouse Fans and Motors serve four boilers, each producing 1,135,000 pounds of steam per hour at 1850 psig and 1,000° F.

Two Forced Draft Fans driven by 900 hp motors provide 219,000 cfm each at 20.1" static pressure.

Two Induced Draft Fans driven by 920/1250 hp motors move 358,000 cfm at 375° F., 10.7" static pressure to each boiler with provision for coal firing.

These mechanical Draft Fans are specifically designed for outdoor installation.

For power generation—or for any other air handling job, let Westinghouse-Sturtevant put air to work for you—economically, efficiently.

FOR MORE FACTS on the industry's most complete air handling line, call on the "Man with the Facts", your Westinghouse-Sturtevant Sales Engineer, or fill in the handy coupon below.

Over-all view of Pacific Gas & Electric Company's Pittsburg Station showing four huge boilers and 16 Westinghouse Forced Draft and Induced Draft Fans.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S

Westinghouse

J-80444

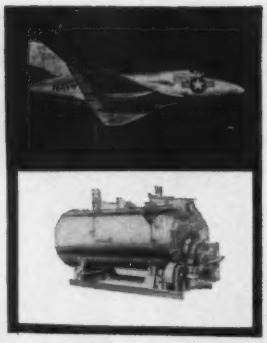
Westinghouse Electric Corporation
Sturtevant Division, Dept. 1E
Hyde Park, Boston 36, Mass.

Please send facts on Westinghouse Mechanical Draft equipment.

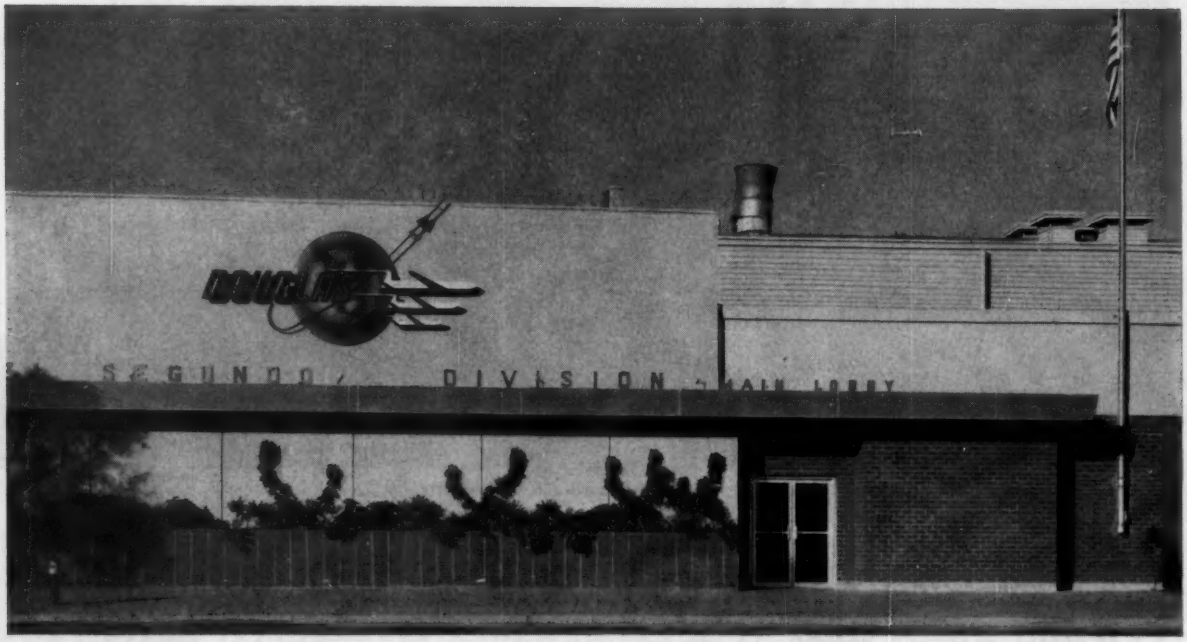
NAME AND TITLE.....

COMPANY.....

CITY.....STATE.....



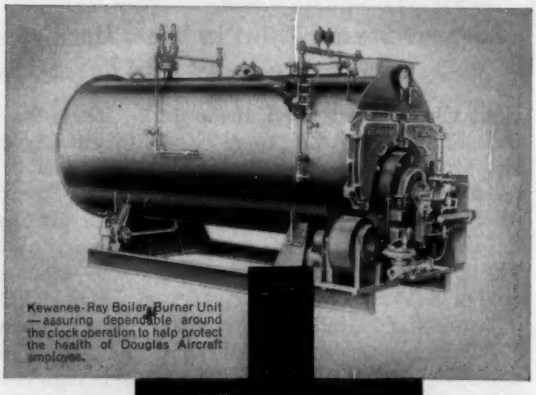
Sisters under the skin . . . when it comes to "cruising speed"



Douglas Aircraft Company, Inc. Division, El Segundo, California
Architect & Engineer: Holmes & Narver, Inc., Los Angeles, Calif.
Heating Contractor: E. Willardson, Inc., Los Angeles, Calif.

■ No one knows the importance of "cruising speed" operation in aircraft better than the Douglas Aircraft people. They know an airplane, to be efficient, to operate economically, to have longer life, must fly at "cruising speed." They know, too, there must be extra reserve power for take-off—for emergencies. So, when it came to boiler selection for the new A4D Skyhawk production facilities at their El Segundo, California Division, it was only natural they turned to Kewanee Reserve Plus Rated Boilers with 50% extra built-in power assuring "cruising speed" operation. For "cruising speed" means less strain—less wear. It means higher efficiency . . . it means lower maintenance and repair costs. Kewanee Boilers are rated on nominal capacity with reserve to take care of normal needs—meet emergencies of the present—fluctuating loads and future expansion. A boiler rated on maximum capacity, operating at constant top speed, requires more maintenance, constant attendance, and finer burner adjustment to maintain efficiency. So, choose Kewanee—for lower fuel and maintenance costs—more efficient "cruising speed" operation.

KEWANEE BOILER DIVISION of AMERICAN-Standard
101 Franklin Street, Kewanee, Illinois



Kewanee-Ray Boiler-Burner Unit —assuring dependable around the clock operation to help protect the health of Douglas Aircraft employees.

KEWANEE
reserve plus rated

KEWANEE BOILERS

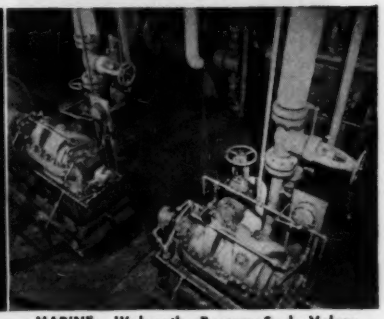
You can depend on Kewanee engineering

WALWORTH *Pressure-Seal* VALVES

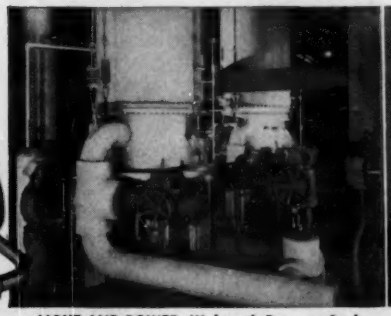
For high-pressure, high-temperature services

Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.



MARINE: Walworth Pressure-Seal Valves aboard the S.S. "Wilfred Sykes"— largest Great Lakes ore carrier.



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

PAPER MILL: Fabricated header with 8-inch Series 600 Pressure-Seal Y-Globe Non-Return Valves and Series 600 Pressure-Seal Gate Valve.

SMALL VALVES FOR HIGH PRESSURE-TEMPERATURE SERVICE

Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

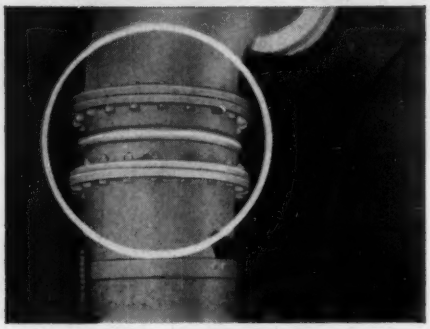
WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

How long can a U. S. Rubber Expansion Joint last



...some have been on the job since 1926, the year they were invented!

Here are just a few reasons why *these flexible connections are used in pressure or vacuum pipe lines...*

- U. S. Rubber Expansion Joints are resilient and, therefore, do not, like metal, set permanently when compressed.
- Constant flexing merely keeps "U. S." joints "alive"...prevents them from becoming brittle.
- They absorb both axial *and* lateral deflection far more than metal joints. Greater insulation against vibration and pump noises is provided.
- There is never any electrolysis, corrosion or erosion.
- U. S. Rubber joints handle pressures from 40 lbs. to 125 lbs. Compare!
- The outside diameter of the arch is smaller than that on metal joints. Face-to-face dimensions (even with multiple arches) are smaller.
- Weight is much less. This, plus the fact that no gasket is needed between flanges (unlike metal joints) results in a more easy installation, lowering the cost.

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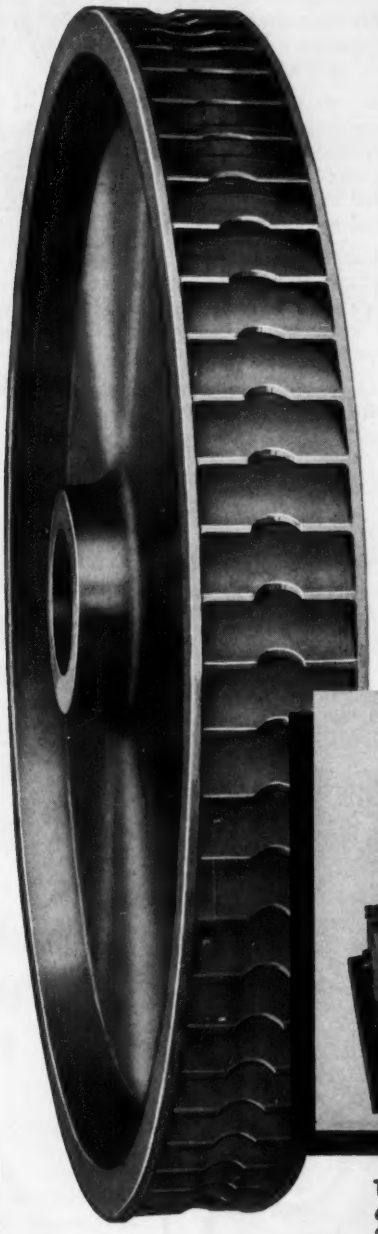

A Terry solid-wheel turbine is simplicity itself. Particularly the rotor. This is a single forging of special composition steel. And, unlike a built-up wheel, has no separate parts to loosen or work out.

Blade wear which might occur after years and years of usage is of little consequence, because the power-producing action of the steam takes place on the curved surfaces at the backs of the buckets. Thus wear does not materially affect horsepower or efficiency.

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Perhaps you, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives complete details. Send for a copy today.

TERRY STEAM TURBINE COMPANY
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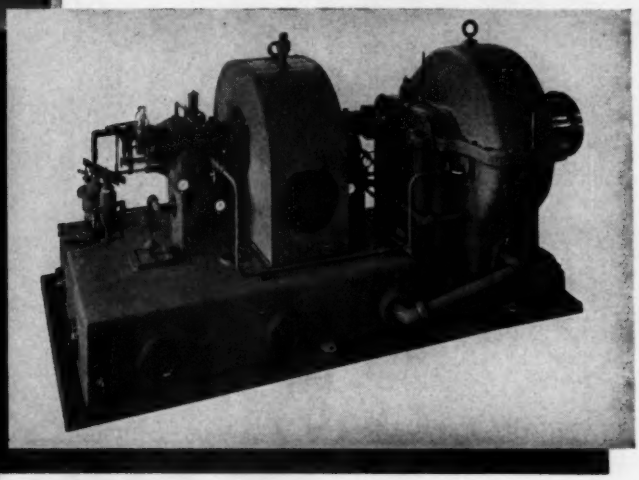

This Terry solid-wheel turbo-geared unit is rated 600 hp, 4000/650 rpm for 820 psi, 825°F steam with 275 psi back pressure.

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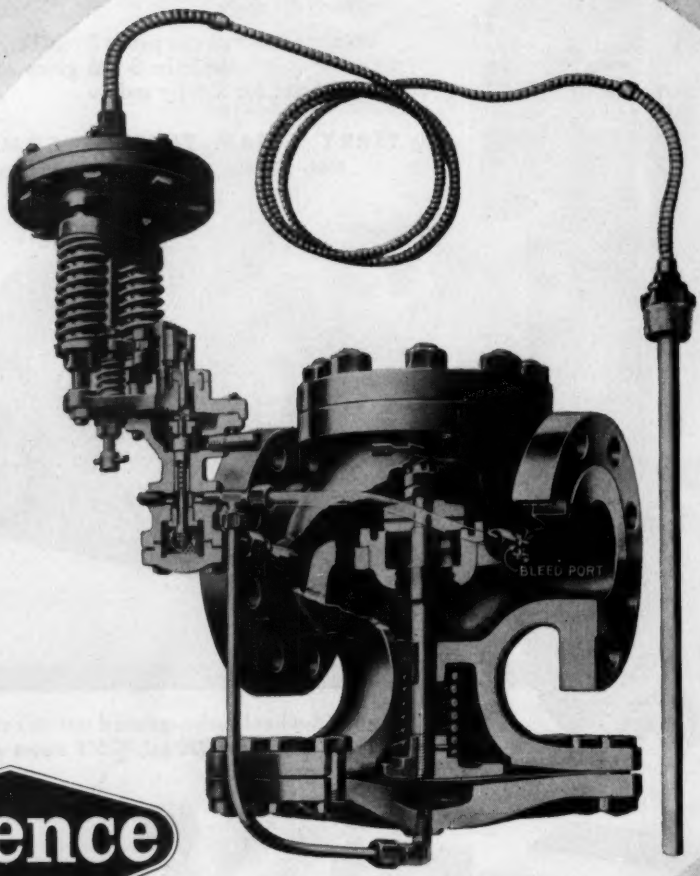

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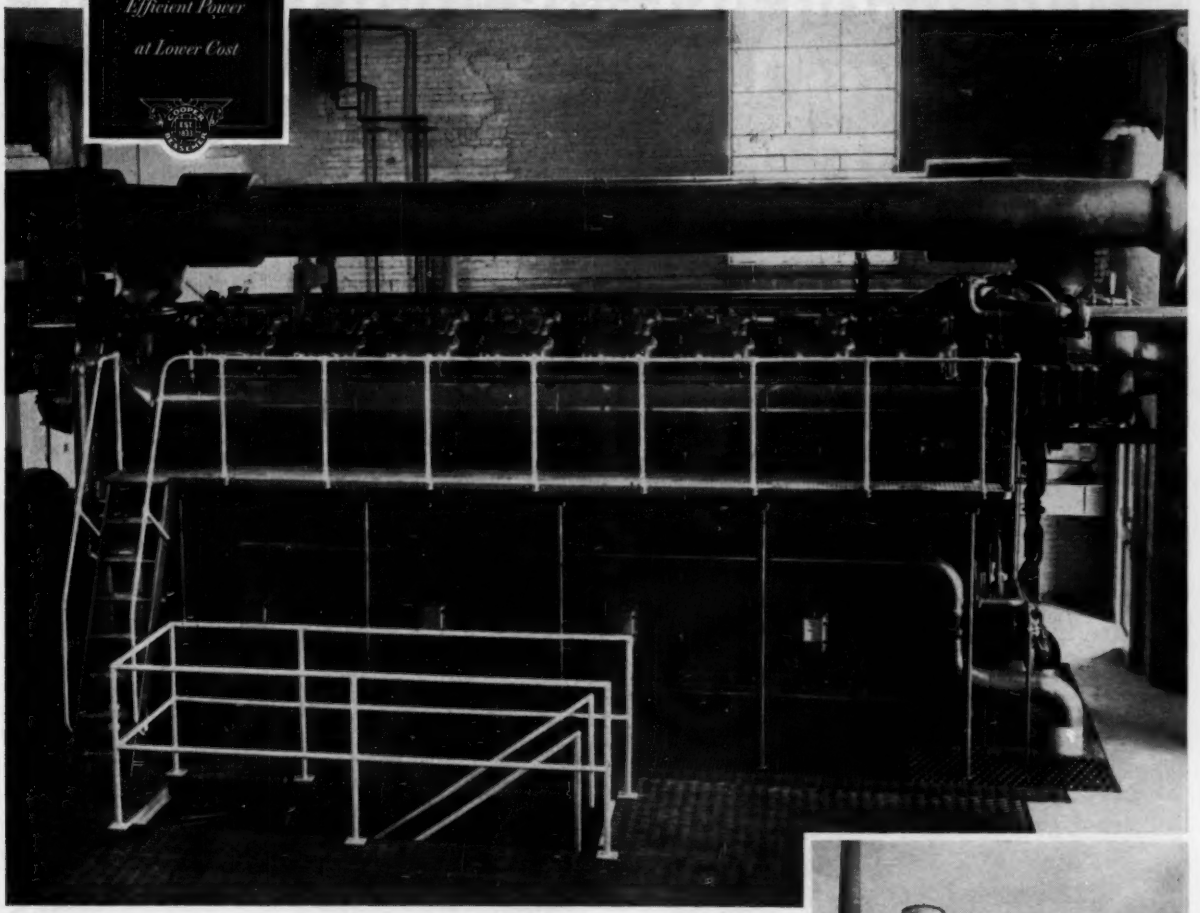
There's a lot of dependable horsepower packed in this 16-cylinder turbocharged Cooper-Bessemer LSV Gas-Diesel. In operation at the Princeton, Illinois municipal power plant, this unit delivers 3,600 hp at 327 rpm.



How Cooper-Bessemer Solved A "Growing" Problem at Princeton Municipal

• Faced with growing power demands and insufficient capacity, Princeton, Illinois installed a 3,600 hp Cooper-Bessemer Gas-Diesel engine to boost generating facilities in their municipal power plant.

Selection of this engine was based primarily on three important Cooper-Bessemer advantages. First was extreme flexibility for continued, low-cost power generation. With the supply of natural gas limited during certain months, the engine can easily be switched to straight diesel fuel or any fuel combination as supply dictates.

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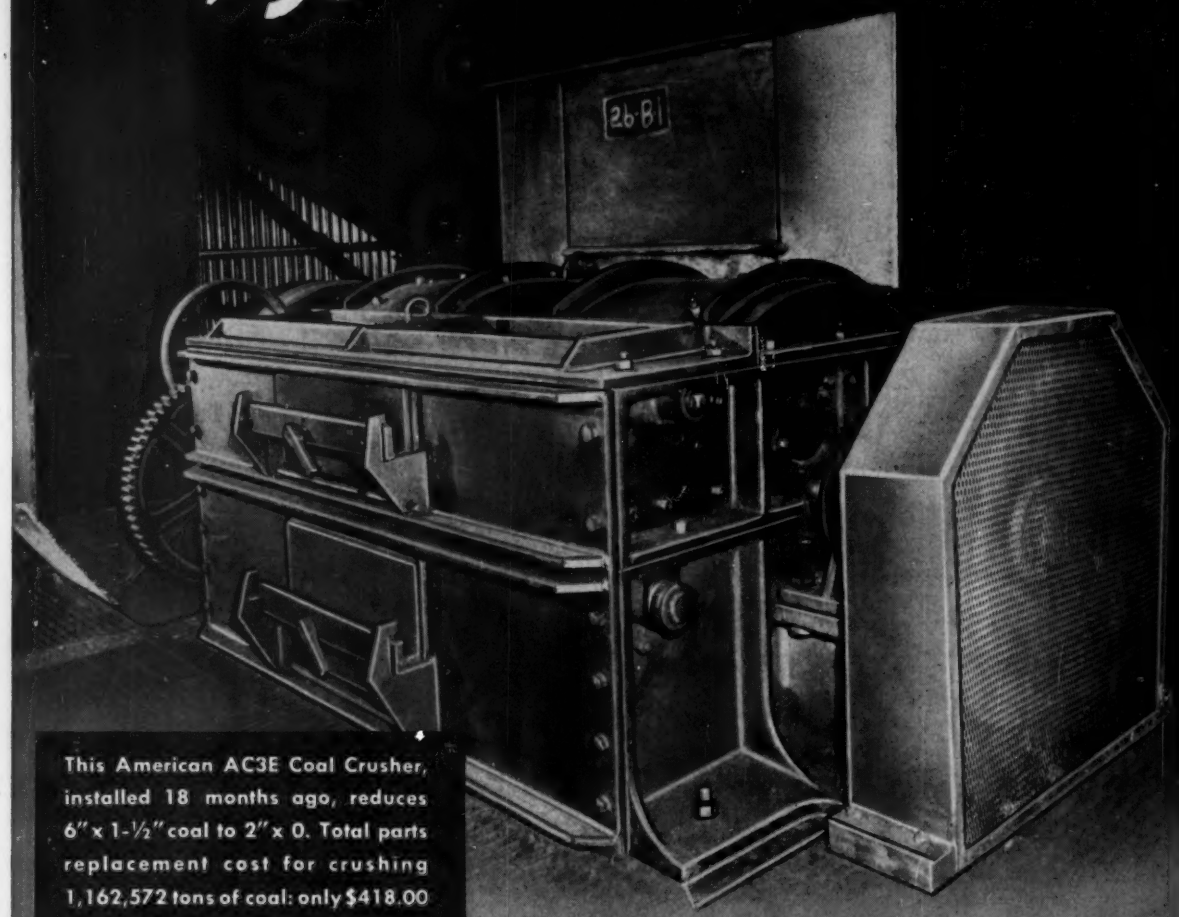
...at parts replacement cost of

1/30th of a cent per ton!



This American AC3E Coal Crusher, installed 18 months ago, reduces 6" x 1-½" coal to 2" x 0. Total parts replacement cost for crushing 1,162,572 tons of coal: only $418.00 or 1/30th of a cent per ton.

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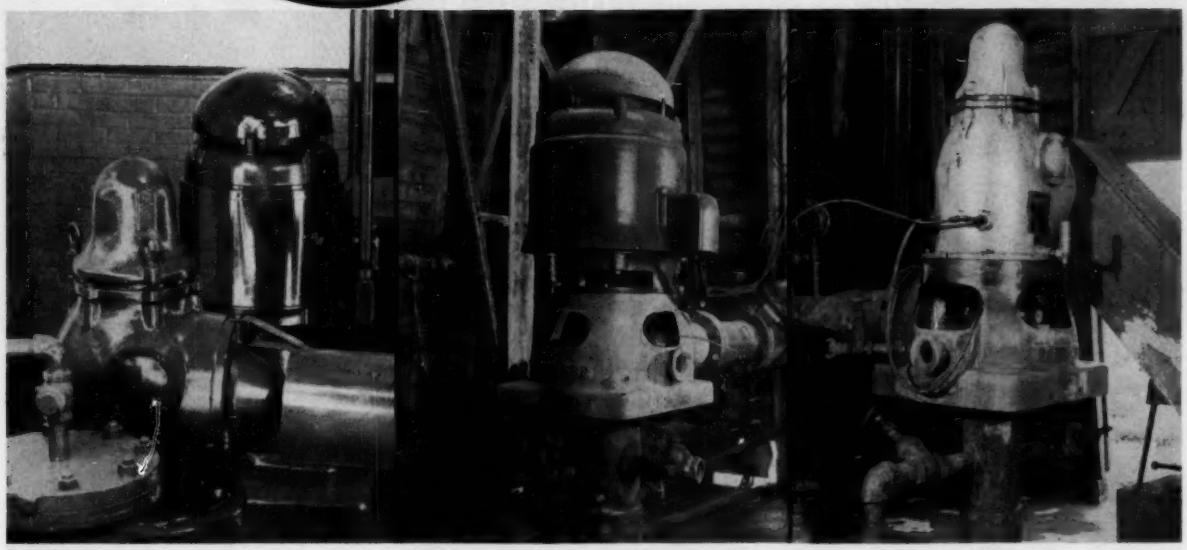

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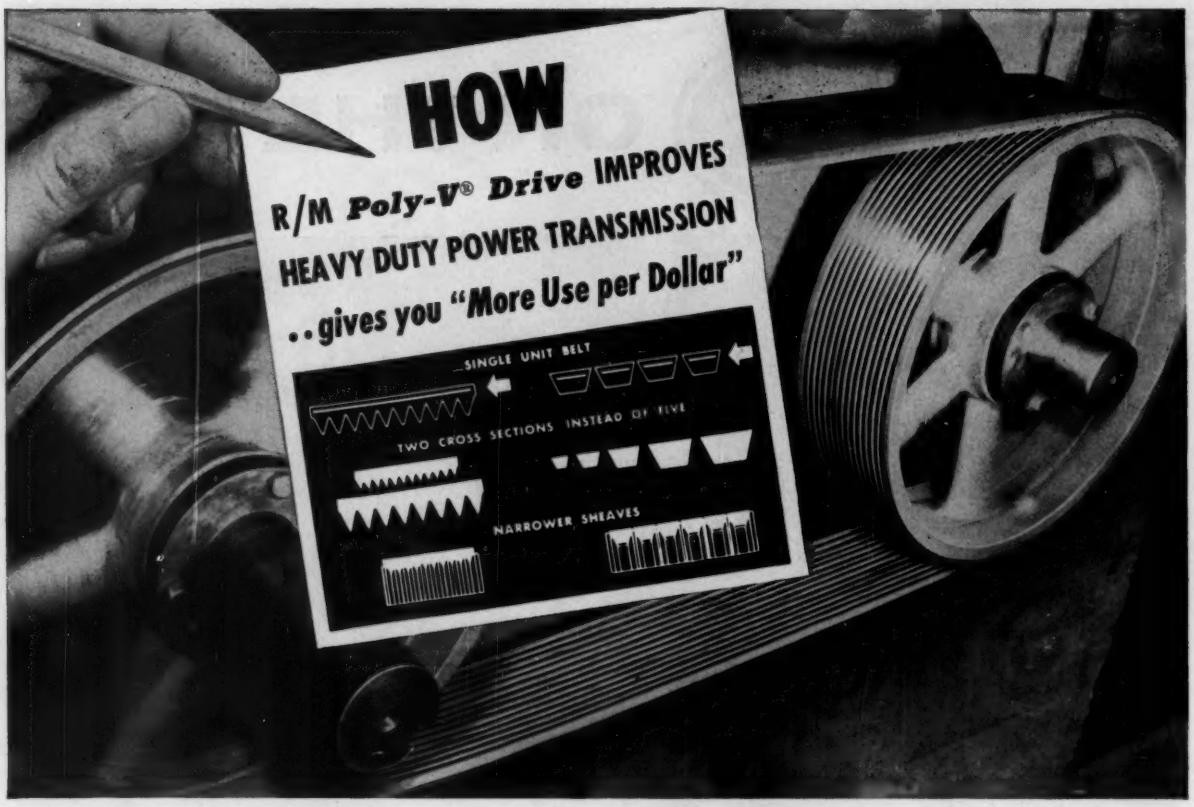

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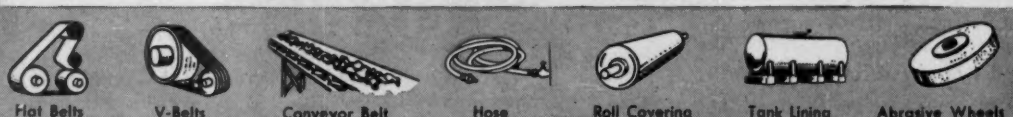

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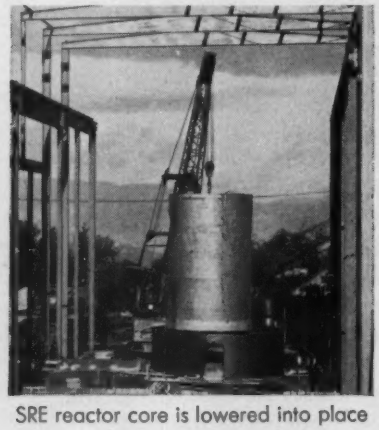
NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Principal Technical Details of the Sodium Reactor Experiment in California

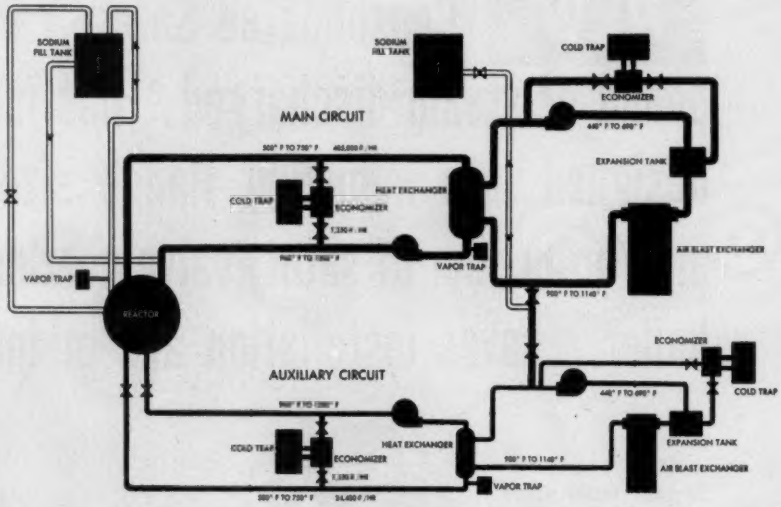
The Sodium Reactor Experiment is an important contribution to the Atomic Energy Commission's program to develop economical power from nuclear energy. Interest in the SRE approach is high. The Atomic Energy Commission has authorized ATOMICS INTERNATIONAL and the Southern California Edison Company to enter into an agreement for Edison to install electrical generating equipment with a capacity of 7,500 kilowatts adjacent to the SRE to convert the reactor's 20,000 kilowatts of heat into electricity which will be fed into the utility's power grid system. ATOMICS INTERNATIONAL and the



SRE reactor core is lowered into place deep in the Santa Susana Mountains

Consumers Public Power District of Nebraska are negotiating for the construction of a 75,000 kilowatt nuclear power plant utilizing a sodium graphite reactor based on SRE experience.

The Sodium-Cooled, graphite-moderated reactor design has many advantages. The use of sodium permits high temperature operation, good steam conditions and high thermal efficiency of power conversion without pressurization of the reactor and coolant circuit. The high thermal conductivity of sodium makes it an excellent heat transfer medium. Sodium boils at 1620°F.—is liquid at 208°F. This permits high coolant temperatures with the system at atmospheric pressure, creating a low-pressure heat extraction system which simplifies reactor construction. Further, the sodium design minimizes chemical reaction between fuel elements, coolants and structural materials—increases safety—allows the use of a variety of steels and alloys in construction.



Sodium Flow Diagram For SRE Cooling System

Nominally Rated Output of SRE with Uranium fuel (enriched with 2.80 atom percent U235) is 20 Thermal Megawatts. The reactor core is made up of fuel rods, moderator cans and control elements interspersed and immersed in sodium coolant. The fuel is composed of 6 inch slugs, 0.750 inches in diameter, formed in 6 foot columns tied in clusters of seven. The graphite moderator elements are canned in Zirconium, fabricated with an axial coolant channel. This prevents absorption of sodium into graphite. Much less costly than beryllium—graphite is also comparatively easy to handle.

Capital and Power Costs in Full Scale Power Stations—At present, with Uranium fuel, capital costs/ installed Kw. are expected to total $300. With Thorium, costs may be $265/installed Kw. Power costs (based on 80% load factor and 15% annual fixed charges) may be 11 mills/kwh with Uranium, 9 mills with Thorium. Future costs with Thorium fuel are expected to be $200/Kw capital cost and 6.5 mills/kwh total power costs.

Atomics International is a major reactor builder—experienced in the design, construction and operation of nuclear reactors for research and the production of power. If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Applications Engineering Service, Dept. PW-N2, ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, California. Cable address: ATOMICS.

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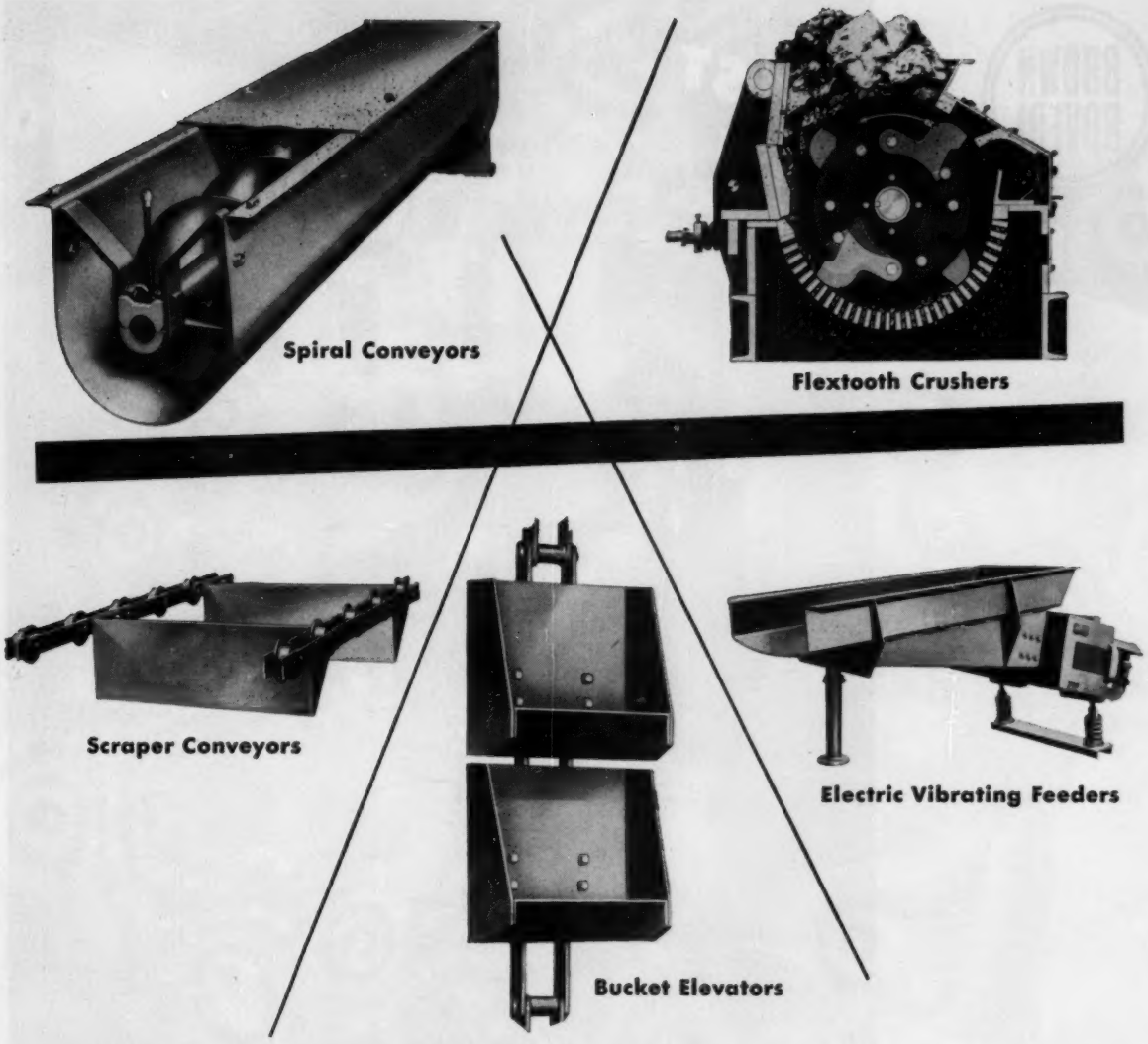

JEFFREY DEPENDABILITY counts most in equipping and operating a power plant

A high standard of design, materials and workmanship has made Jeffrey coal and ashes handling equipment the choice of leading power plant engineers. Whether you're planning a complete plant or revamping an old one, consider these Jeffrey products—

Spiral Conveyors for distributing coal to bunkers and hoppers are ideal where space is limited and capacity demands are not high. Coal can be discharged at any point by means of valves in trough bottoms. Available in various standard lengths.

Flextooth Crushers reduce lump coal to uniform sizes in a single operation, assuring maximum efficiency for mechanical stokers. An adjustable breaker plate permits making a wide range of sizes.

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The Scraper Conveyor is one of the simplest of conveying units. Flights of various shapes, attached to either single or double strands of chain, drag the material in a steel trough. Operation may be horizontal or on an incline.

Detailed information on Jeffrey equipment for power plants is available upon request. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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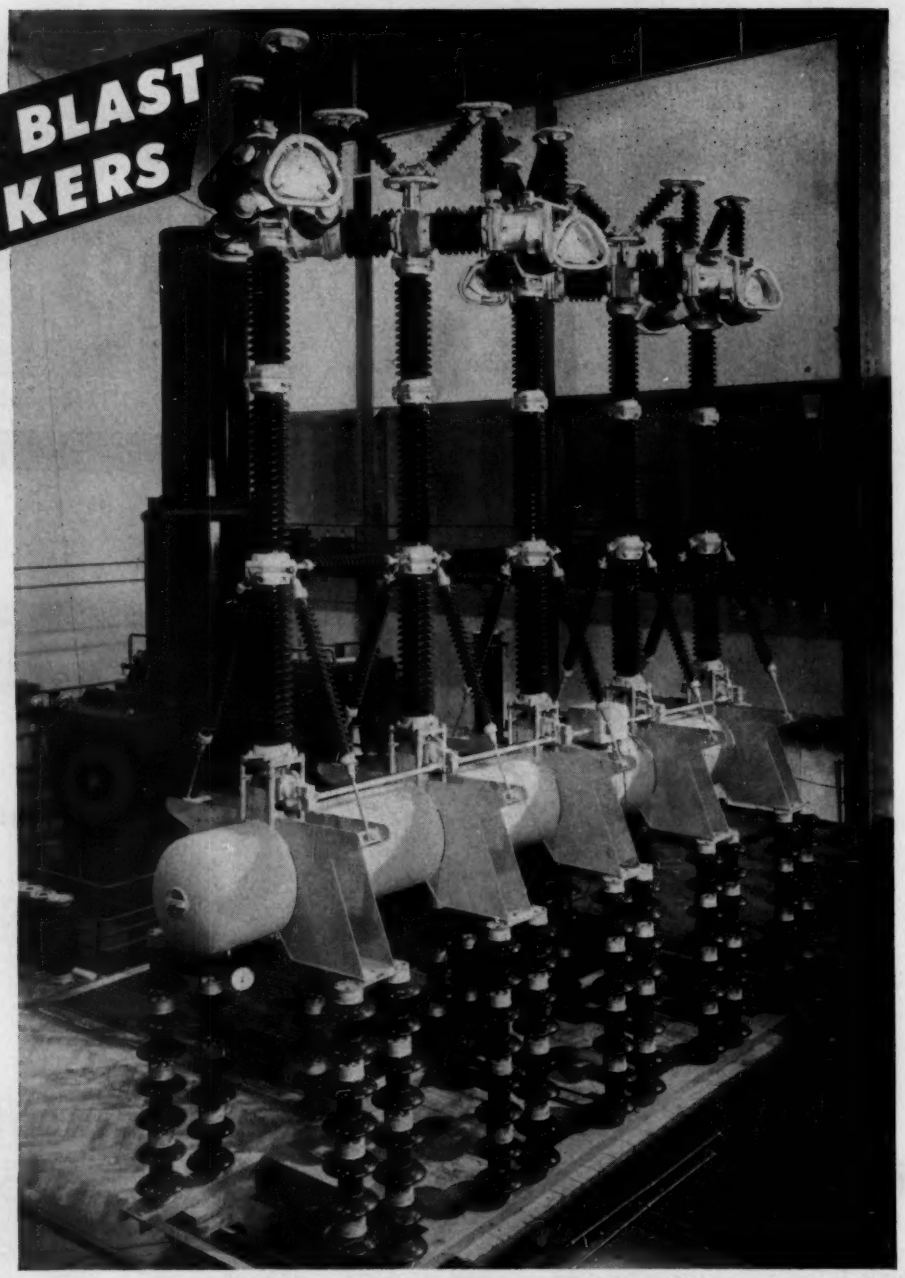

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THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

How Critical Is It?

The United States is running into a serious shortage of scientists and engineers. There is no novelty in this observation. It has often been made in the last few years. And there has been mounting alarm about what this shortage may mean for both our national security and our prosperity.

There would be great novelty, however, if general agreement were attained on such important matters as the size of the shortage, the extent of the damage it threatens to inflict, and the best ways to eliminate it. The purpose of these editorials is not to provide this novelty, but to ventilate some of the key aspects of the shortage of scientists and engineers.

This first editorial in the series is designed to throw light on the over-all dimensions of the shortage. Others to follow will be addressed to such questions as:

- How serious is the threat to our economic well-being and to our national security?
- What needs to be done to prevent the shortage from becoming critical?

Rise Has Been Rapid

The problem is *not* that we have been producing a small number of engineers and scientists. Indeed, the number has risen sharply. We now have a working force of more than 600,000 engineers, over twice as many as the 286,000 there were in 1940. And we have about 250,000 scientists (chemists, physicists, biologists, geologists, mathematicians, etc.), compared to only 92,000 in 1940. About one in 148 persons in the labor force of 1940 was a scientist or engineer; today the ratio is about one in every 80.

In research and development work, where highly creative scientific minds are required, there has been fully as rapid a rise in employment of scientists and engineers. Fewer than 90,000 were employed in research and development fifteen years ago; the total now exceeds 200,000.

—But Not Rapid Enough

Despite this rapid increase in the number of scientists and engineers—at a rate much faster than the increase in the labor force as a whole—the needs of industry, government and education for technically trained people have risen even more sharply.

The principal reason for this mounting demand is the prodigious growth of research in the last 15 years. From a total of only about $900 million spent on all types of research in 1941, the annual expenditure rose to over $5 billion by 1953 (the latest estimate available). Over two-thirds of the research is done by private industry, mostly to develop new and better products and to find new and better methods of production. Most of the rest is performed by the government, largely to develop improved and inevitably more complex scientific weapons.

One aircraft company has found from its own experience that it required 17,000 engineering manhours to develop a typical fighter plane in 1940. The requirement is now about 1.4 million engineering manhours. Development of the typical fighter plane of 1960 will require well over 2 million engineering manhours.

In this dramatic example, the need for engineering services for a basic piece of military equipment soared 80 times in 15 years. It is an indication of why the demand for more and more technically trained men and women has outstripped even the imposing increase in scientific and engineering manpower of the last decade and a half.

Size of the Gap

Exactly how great the gap is between the available supply of scientists and engineers and the number required, it is impossible to say. In some instances technical talent undoubtedly could be better used than it is now. And part of the shortage might "disappear" if higher salaries had to be paid. (These questions will be discussed in later editorials.) But informed estimates of the approximate size of the gap can be given.

- According to the best available information, from estimates by the Engineers' Joint Council and the U. S. Bureau of Labor Statistics, **the minimum need for engineers from graduating classes is 40,000 each year for the next ten years.** Last year we graduated only 23,000 engineers, just about enough to cover replacement needs without allowing for any expansion of the number of active engineers. Projections made by the U. S. Office of Education indicate that we shall probably not have a class of 40,000—the *current* annual requirement —until 1963.
- According to Dr. Howard Meyerhoff, executive director of the Scientific Manpower Commission, **there is now a shortage of about 20,000 scientists.** Last year the number of doctoral degrees in the natural sciences, almost a prerequisite for research work, was only 5,000. Dr. Meyerhoff estimates that the shortage of scientists will rise another 30,000 by 1960.

More Needed As Teachers

Not all of the graduates with scientific and engineering training, furthermore, will work as scientists and engineers—that is, by performing research and giving it practical application. Such training is now necessary in many sales and management positions. And more of our technically trained men and women must remain in educational institutions as teachers if the quality of engineering and scientific education is to be maintained. A survey in 1954-55 by the National Education Association showed that, out of 277 universities, state colleges and large private colleges, nearly one-third *already* had unfilled vacancies in engineering and three-fourths had vacancies in physical sciences.

The dimensions of the shortage of scientists and engineers can be summarized as follows: **Despite a substantial rise in the trained manpower available, the needs of industry, the government and education have risen still faster. The best information indicates that, on the basis of current and anticipated needs, our recent yearly rates of production of slightly over 20,000 engineers and about 5,000 PhD's in natural sciences could be doubled without closing the gap entirely.**

The disturbing implications of this shortage for our national security and our prosperity and some practical suggestions for eliminating it will be the subjects of subsequent editorials in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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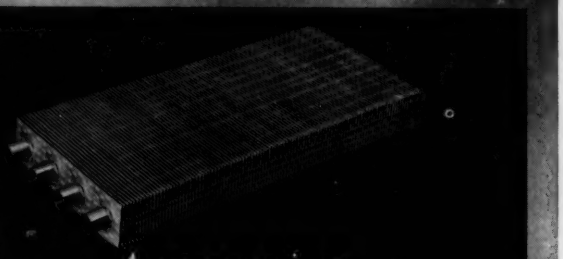

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"TURBU-FLO" assures you of extra-safe capacity ratings, for the added heat transfer it provides means an unusual margin of *added* capacity.

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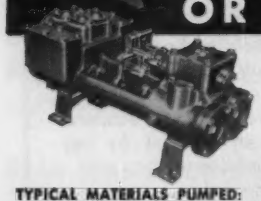
Mechanically handles materials from grain size to lump . . . sand, rice, seed, pellets, flakes, steel chips, wood waste, coal, etc.

OR LIQUIDS?



WAGENER PUMPS
SIMPLEX DUPLEX

STEAM or POWER models for any need

TYPICAL MATERIALS PUMPED:
ACIDS, ALCOHOLS, BEER & POTATO MASH, DYES, GLUE, OIL (any kind), ASPHALT, BRINE, MILK, MOLASSES, SOAP, SEWAGE, WATER, TAR, GROUT

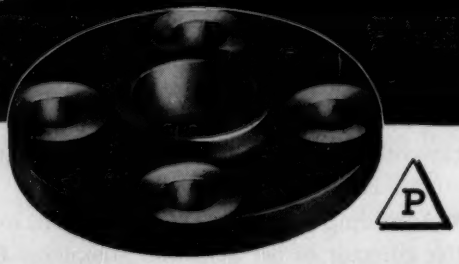
MADE and GUARANTEED BY THE
Specialists in Automatic Coal FIRING, HANDLING and CONTROL Equipment and CANTON INCINERATORS

CANTON STOKER CORP.
CANTON STOKERS

741 ANDREW PL., CANTON, OHIO
PHONE GLendale 3-9133

PHOENIX *Drop-Forged* FLANGES MEAN . . .

MAXIMUM STRENGTH



Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

NEW CATALOG!
Send for free brochure showing Phoenix Complete Line.

FLANGE DIVISION
PHOENIX MANUFACTURING CO.
Catasauqua, Pa. • Joliet, Ill.

General Contractor: Cauldwell Wingate Co.
Heating & Ventilating Contractors: Raisler Corp.
Architects: Kelly & Gruzen
Consulting Engineers: Jaros, Baum & Bolles

845 feet of steam, condensate and return lines run from college power plant to science building (background). Note spot-welded rods prevent pipes from shifting on supports while pipes are being laid.

Another university approves GILSULATE® for hot underground pipe insulation

Albert Einstein College of Medicine in New York City, the newest of American medical colleges, chose GILSULATE to insulate and protect 845 feet of pipe running from its power plant to its basic science building.

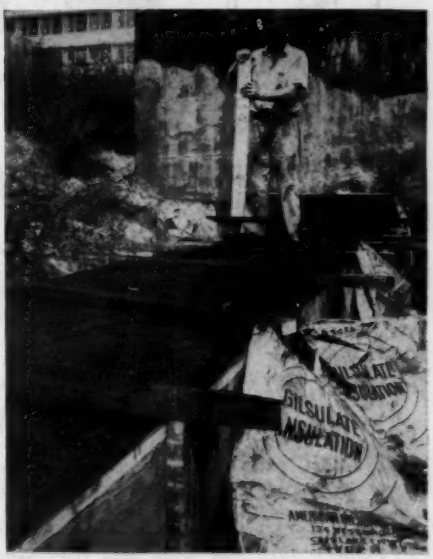
Covered by 138 tons of GILSULATE —with only six men doing the job— are a 10-inch 185-pound steam supply line; 2-inch high pressure return; and a 6-inch condensate line. Pipes were surrounded with an 8-inch envelope of GILSULATE, except under roads and driveways where thickness was increased to 11 inches.

GILSULATE was approved because no other insulation for hot underground pipes could match it in corrosion protection and low cost of installation. It will pay you to investigate this revolutionary material for your next piping job. Fill in the coupon below for more details.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS:** no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING:** for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220°-300°F. temp. range
   Type B for 300°-385°F. temp. range
   Type C for 385°-520°F. temp. range

Inexpensive plywood forms were put up to confine the GILSULATE to the area required and cut down on tonnage needed. Men in background are in front of one of the four access chambers.



138 tons of GILSULATE were poured and tamped around the pipes by six men in good time—which included a two-mile truck haul from a railroad siding to the job site. Type B GILSULATE was used—the three protective zones were formed in eight hours.

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

American Gilsonite Co.
134-F West Broadway, Salt Lake City 1, Utah
or
1145 East Jersey St., Elizabeth, N. J.

Send me more information on GILSULATE Insulation

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

P

Don't wait until the Packing goes!

Your present packing may be good enough, but here's proof that PALMETTO Pyramid will do the job better!

OIL FIELD WATER FLOODING—*Triplex plunger pumps handling abrasive salt water or oil at 4400 psi, 150 F —— PALMETTO Pyramid out-performs all other Vee-type packings in this application.*

FORGING OPERATION—*5000 lb. steamdrop hammer wore out a set of conventional square packing every 2½ weeks. PALMETTO Pyramid 2500 lasts 17 weeks under the same operating conditions.*

PLASTIC MOLDER—*Molding press using 130 F oil at 2000 psi, and operating on a 1-minute heat cycle for three shifts each day of a seven-day week, wore out its packing every week to two months. PALMETTO Pyramid 2510 now being used gives better than 1½ years of service life.*

PALMETTO Pyramid packings are designed for rugged service, made of top quality material and molded to meet the demands of the application. If you are having packing problems, our nearest representative will be glad to help you. If you need a Vee-packing that lasts longer, order PALMETTO Pyramid now—from your nearest distributor listed in Thomas' Register.

Write for Bulletin PC-102

packing more performance into every application

PALMETTO Packings

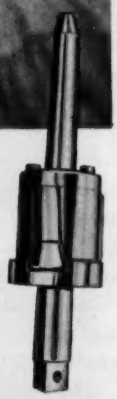
GREENE, TWEED & CO.

NORTH WALES • PENNSYLVANIA

PLAY SAFE!...

Roll tubes the WILSON Way

Rolling tubes in high pressure boilers, superheaters, economizers, marine steam generators and other heat exchange equipment is simple *and* safe with Wilson Tube Expanders.



Wilson Tube Expanders offer smooth, efficient rolling action, which insures firm seating of the tube, provides perfectly rolled joints, reduces time-wasting re-rolling and re-inspection. For example, Wilson Model 38 Tube Expander, shown here, is a popular tool which rolls and flares in a single operation. It is available for tubes from 1" OD to 4½" OD with various roll lengths for tube sheets ½" and up in thickness.

FREE Wilson Catalogs

Write for new Wilson Tube Cleaner Catalog 77 and comprehensive Tube Expander Catalog. ➔

Representatives in all principal cities

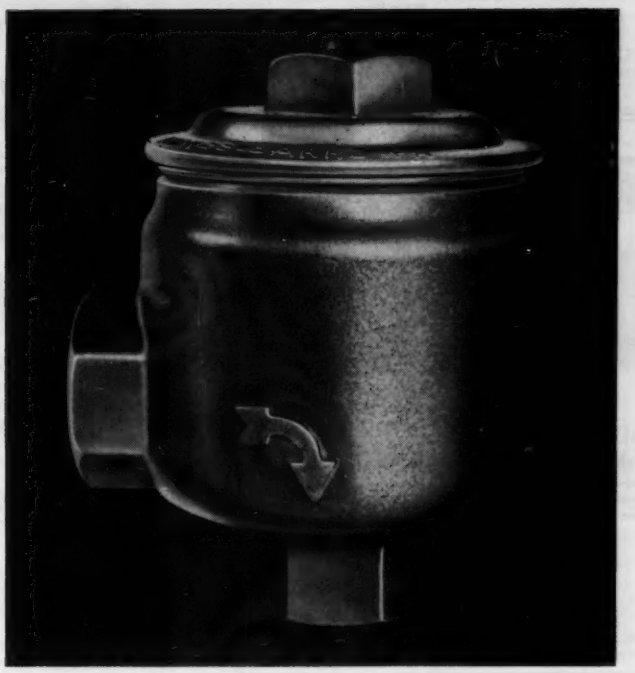
THOMAS C. WILSON, INC.

21-11 44th AVENUE, LONG ISLAND CITY 1, N. Y.

CABLE ADDRESS: "TUBECLEAN" NEW YORK

WILSON TW846

TUBE CLEANERS • TUBE EXPANDERS



Nicholson *steam trap* simplicity *gives you*

peak performance, low-cost maintenance

Write, today, for your copy of new Bulletin 10-55—for detailed information.

Nicholson simplicity of design and operation pays off big in any plant . . . in greatest efficiency of steam distribution . . . in easy, low-cost maintenance. Nicholson traps offer the most effective method for discharging condensate and air from steam lines.

- **one moving part—big husky bellows.**
- **positive shut-off—no waste of steam.**
- **high capacity—effective use of large orifice.**
- **each unit service tested—with steam.**

When less than the best won't do, specify Nicholson.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES

WHERE TO BUY

Featuring additional products specialties and services for power plants

HILL PUMP VALVES

Since 1905

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate

Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

STEEL PIPE & TUBING
● CHROME MOLY ● CARBON MOLY
● MONEL ● CARBON STEEL ● STAINLESS
● HASTELLOY
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
Send us your Surplus Lists
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

HIGH PRESSURE GASKETS

All sizes to fit your gages
ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

POWER — Classified Advertising

PROFESSIONAL SERVICES

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
1706 Broadway Kansas City 12, Missouri

THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Ave., New York, N. Y.
Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Mechanical — Electrical — Civil
Surveys Reports Design
101 Park Avenue New York 17, N. Y.

BURNS & McDONNELL
Engineers — Architects — Consultants
Kansas City, Mo. Phone
P. O. Box 7088 DElmar 3-4375

LUTZ AND MAY COMPANY
Consulting Engineers
Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals
1009 Baltimore Kansas City 6, Mo.

J. E. SIRRINE COMPANY
Engineers
Power Plant Consultations
Design Reports
Water Steam Utilization Plants
Greenville South Carolina

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing
New York Reading, Pa. Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. Chicago 4

STANLEY ENGINEERING COMPANY
Consulting Engineers
327 S. La Salle Street Hershey Building
Chicago 4, Illinois Muscatine, Iowa

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

FRANK C. REYNOLDS
Registered Consulting Engineer
Surveys, Reports, design and construction supervision of air conditioning, heating, ventilating, oil and gas burners & control systems.
136 Liberty St. New York 6, N. Y.

A. L. SWANSON AND COMPANY
Consulting Engineers
Power Plants
Sawmills—Industrial Plant Layout
Heating—Ventilating—Plumbing
Reports, Designs, Drawings, Specifications
2210 West 12th Avenue Vancouver 9, B. C.

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SANDERSON & PORTER
Construction
REPORTS SURVEYS
New York New York

WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for Corrosion Prevention
Main Office:
423 W. 126 St. New York 27, N. Y.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

RATES

DISPLAYED
The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.
Subject to Agency Commission.

UNDISPLAYED
$1.65 per line, minimum 3 lines. To figure payment count 5 average words as a line. Box Numbers—counts as 1 line. Position Wanted ads, ½ of above rate.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS and inquiries to Classified Advertising Division of POWER, 330 W. 42nd St., N. Y. 36, N. Y.

WANTED CHEMIST

At Modern, Midwestern, High Pressure, Pulverized Fuel Fired, Steam Electric, Generating Station. Must be Graduate Chemist.

Write Stating Education, Experience, Salary Expected And Availability To:

ELECTRIC ENERGY INC.
P.O. BOX 165 **JOPPA, ILL.**

ELECTRICAL SALES ENGINEER

Salary $450.00 to $700.00. Age 25 to 35. Will accept a trainee and/or five years sales or more experience. Prefer B.S.E.E. and/or equivalent. Products are used in terminating power cables, heavy electrical switches, oil fuse cutouts, and splice kits for voltages from 600 to 230,000. Learn products and customers needs by working in general sales office and plant, then call on representatives and dealers to instruct in use and application of products. Location: Illinois. Send two copies of resume. State acceptable starting salary. *Confidential. No obligation.* Refer to position number J-9049.

LOGSDON COMPANY
19 W. Jackson Blvd., Chicago 4, Ill.

APPLICATION ENGINEER

Prominent manufacturer located Midwest has excellent opportunity for man with at least 3 years experience in internal combustion engine application engineering as related to fluid flow design of cooling water, lubricating and fuel oil, and air piping in power plants. Must have ability to calculate size of auxiliary pumps, coolers and so forth. Some knowledge of machine design and engineering mathematics essential. Must be able to handle all application engineering required by engine contracts. Write stating age, experience, and salary expected. Replies strictly confidential.

P-1334, POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you
CHICAGO: 520 N. Michigan Ave. (11)
NEW YORK: 330 W. 42 St. (36)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Wanted detail and design draftsmen with minimum of one year experience in power boiler detail drafting. Please give age, schooling, experience and minimum salary requirements. Springfield Boiler Co., Springfield, Illinois.

Mechanical Engineering Graduate with experience in power and heating plant installation for inspection of construction in Canada for an engineering organization of 60 years in business. Give full details of experience, education and availability. Salary $10,000 per year. P-1381, Power.

EMPLOYMENT SERVICE

Salaried Personnel, $5,000-$30,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, P.O. Box 674, Manchester, Vermont.

POSITION WANTED

Diesel Engineer—seeks position as diesel power house superintendent or foreman. Have 4 years experience as merchant marine diesel engineer; 3 years experience as foreman for a privately owned power company, and 4 years as assistant superintendent for same company. For the past 14 months have been employed as chief diesel engineer for an R.E.A. Co-op. Age 32, married, five children, with a high school education, can furnish excellent references. PW-1497, Power.

WANTED:

ELECTRICAL DISTRIBUTION EQUIPMENT SALES REPRESENTATIVE

National manufacturer of Electrical Distribution Equipment desires experienced sales representative in Milwaukee trading area. Applicants must be acquainted with architects, engineers, industrials and utilities. Send complete resume of qualifications and experience to:

P-1442, POWER
330 West 42nd St., New York 36, N. Y.

PART TIME WORK WANTED

Steam Turbine Heat balance calculation specialist available part time. Outline of qualifications on request. PTWW-1444, Power.

SELLING OPPORTUNITIES WANTED

Sales Engineer desires additional line New York area. SA-8831, Power.

Manufacturers' Representative covering power and industrial firms in territory desires equipment lines for Eastern Pennsylvania, Delaware and Southern New Jersey. RA-1426, Power.

If you want a Package-Boiler Sales-Engineer who can go out and find customers for you, and has plenty of experience as Chief Engineer to help solve those customers' tricky steam problems, here is a 33 year old, top income-bracket operating engineer who is bored with his smoothly running power plant and wants to make a change. Would like to work with a reputable package-boiler manufacturer or dealer to increase sales volume, preferably in the Pacific-Northwest, but could move anywhere for sufficient opportunity. Proven sales ability. Can handle own installation, start-up and service. Straight commission only. Reply RA-1368, Power.

ENGINEER

atomic era caliber

POWER PLANT

If you are a mechanical engineer with broad specialization in design and development of steam power stations, you can help move the coming nuclear energy revolution out of its infancy and into lusty manhood.

We are not looking for a comfortable-rut thinker. We want someone whose inner growth is just as important to him as it is to us. He is the engineer whose working knowledge of power system stability, heat transfer and turbine performance under varying pressure and flow conditions can be put to creative use in a new field. A background in electrical system reliability, characteristics and problems is also desirable.

Write in confidence to General Electric, the organization whose unique Personnel Development and Benefit programs are designed to help you grow in the career you are looking for. Personal interviews will be arranged with all selected candidates.

Mr. E. P. Galbraith
Technical Personnel Placement
GENERAL ELECTRIC
RICHLAND, WASHINGTON

STEAM POWER ENGINEER

Steam Power Engineer for large New England Utility. Attractive permanent position open for mechanical engineering graduate with broad background of responsible design experience in modern steam power generation who has served as Principal Project Engineer for two or more public utility steam power plant developments of 75,000 KW or greater capacity. Age range 40-50.

P-1529, POWER
330 W. 42nd St., New York 36, N. Y.

ENGINEERS

MECHANICAL • ELECTRICAL

Caterpillar Tractor Co., the world's leading manufacturer of diesel tractors, motor graders, engines and earthmoving equipment has openings for Graduate Engineers in their Plant Engineering Department. Electrical Engineers with Power Distribution, Factory and Office Lighting experience and also Mechanical Engineers with Heating, Ventilating and Air Conditioning experience in conjunction with the design of new plant facilities are urged to apply. Security, advancement and excellent working conditions are offered to qualified men.

Interested applicants are requested to send full particulars of experience and education to Mr. R. R. Haarlow, Professional Employment Co-ordinator:

EMPLOYMENT DIVISION
CATERPILLAR TRACTOR CO.
PEORIA, ILLINOIS

WANTED MAINTENANCE ENGINEER

By a Midwestern Public Utility Company. Graduate Mechanical Engineer or equivalent, with a minimum of five years experience in High Pressure Power Plant Maintenance. A high caliber man is required in the planning, scheduling and advisory capacity relating to pulverized fuel fired, steam-electric plant maintenance.

Write stating education, experience, salary expected and availability to:

P-1309, POWER
520 N. Michign Ave., Chicago 11, Ill.

POWER PLANT PERSONNEL

A middle east coast utility now constructing a new high pressure steam-electric generating station will accept applications for employment from qualified persons for the following positions, which are available immediately.

Shift Supervisors

To take charge of operation on shift. Must be thoroughly conversant with all phases of modern high pressure, pulverized fuel power plant operation; both electrical and mechanical. Must have previous supervisory experience in power plant operation.

Control Room Operators

Well qualified men needed to operate modern high pressure power plant equipment from an air conditioned central control room. Must be experienced in the actual operation of high pressure pulverized fuel, gas, or oil fired boilers, switchboards, pumps, condensers and associated auxiliary equipment, and be able to direct lower grade operators on shift.

Engineer (Recent Grad.)

Graduate Mechanical Engineer. No experience required but applicants should have a real desire to enter modern power plant work. Will assist Results or Test Engineer in the handling of power plant testing, results work and accounting.

Instrument Mechanics 1/C

For men competent in the installation, repair and calibration of all types of industrial instruments, such as flowmeters, remote transmitters, recording pyrometers, pH and conductivity recorders, automatic combustion controls, etc.

Power Pl. Electricians 1/C

Must be qualifed in all phases of modern power plant electrical maintenance. Required to read electrical blueprints and "shoot" trouble on complicated control boards and relay systems.

Water Plant Operators

Experienced in operation of water plant equip. including softeners, filters, sludge tanks, chemical feeders, pumps and chlorinators. Must do simple water tests.

Job is located near excellent residential community, good working conditions, forty hour week (paid vacations, insurance, sick pay and retirement plan).

High caliber men are needed to fill the foregoing jobs, and for applicants meeting the above requirements, consideration will be given to reimbursement of expenses incurred for the moving of household goods and personal effects.

All personnel selected will receive training at full pay in order to familiarize themselves with the plant before assuming their duties. Include a complete resume of experience and qualifications in first letter. All applications will be treated confidentially.

P-1090, POWER
330 W. 42 St., New York 36, N. Y.

An employment advertisement in this EMPLOYMENT OPPORTUNITIES section will help you find the engineers you need. It's an inexpensive, time saving method of selecting competent personnel for every engineering job in the nuclear field.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED RATE:

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS $1.65 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W. 42nd St., N. Y. 36, N. Y. for June issue closing May 8th.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

Prepare for

REFRIGERATION LICENSE

More than 300 multiple choice questions from past exams. Many sketches. 96 pages 8½" x 11". Send $3 to:

W. D. TURNER

44 West 63rd St., New York 23, New York

WANTED

1—150 HP boiler—15 psi—with bituminous stoker

1—100 HP boiler—15 psi—with #5 oil burner

1—#5 oil burner for a 35 HP boiler

These items are for Carolina installations

MAIN LINE BOILER CO.

Dewey Building, Philadelphia 2, Pa.

Rittenhouse 6-4335

WANTED

Two Boilers now—Two more later—water tube preferred with stokers. Approximately 200 horsepower each—175 or 200 pounds pressure—Also two 2300/3/60 steam engine generator sets—vertical preferred about 200 KVA each.

SOUL CLINIC INC.

Calgary, Alberta, Canada

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers or Complete Power plants.

PAUL OBERMAN

1910 Delmar St. Louis, Mo.

WANTED

Ca. 1600 HP. Diesel Engine

GM or Fairbanks-Morse preferred.

W1377 POWER

330 W. 42 St., New York 36, N. Y.

---

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	2200	G.E.	450
450	440	Whse.	514
400	4000/2300	Whse.	450
400(2)	2300	G.E.	900
300	2200/440	G.E.	720
300	440	G.E. (hoist)	600
300	440	Whse.	3600
250	2200/440	G.E.	1200
250	440/220	Whse.	600
250	550/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	440/220	Whse.	514
150(2)	440/220	G.E.	720
150	2200/440	G.E.	600
125	550/440	G.E.	1200
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2260	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	2200/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
400	2300/4000	Whse.	CS	720
400	2300/4000	G.E.	K	1800
350	440	G.E.	KT	1200
300	2300/4000	L. Allis	FS	1800
250	2300	Whse.	CS	900
250	2300	G.E.	K	900
225(2)	2200/440	G.E.	KT	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	JK	600
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G.E.	KT	720
150	2200/440		KT	600

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V., Whse.
1—225 kva 60 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Czndit, 3P, 25 KV outdoor
1—400 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	El. Dyn.	B/brg.	600
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
240	G.E.	4000/2300	Syn.	250
175	G.E.	220/440	Syn.	230
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
125	G.E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1—600 kva, Standard, 13,800—2300 V., 3 ph.
3—333 kva, G.E., 23000/11500—2300 V.
3—333 kva, Mod. 13,800—2300 V.
3—333 kva, G.E., 2400—480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, Mod., 13,800—2300 V.
3—200 kva, G.E., 2300—575 V.
3—100 kva, Al. Ch., 2400—480/240 V.

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Syracuse 8, New York

GUARANTEED REBUILT POWER EQUIPMENT

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 Volts or Higher)

HP	Make	Type	Speed
2000	*G.E.	MT	600
1250	*Al.-Ch.	ANY	1800
1250	*Westg.	CW	600
1000	*Westg.	CW	250
700	*Al-Ch.	ANY	1200
600	*G.E.	MT	450
500	Westg.	CW	350
500	Westg.	CW	900
400	Al-Ch.	3 brg.	450
300	*G.E.	IE-13A	1800
250	*G.E.	I-M	450
250	Westg.	HF-15H	600
200	G.E.	IK-15B	900
200	G.E.	1M	600
150	Cr. Wh.	50-R	1800
150	G.E.	MT-540	1800
150	*Wagner	RS-151	900
150	Westg.	CW	450
125	G.E.	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	1M	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	1M	1200
75	Al. Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al. Ch.	ANY-26F	900
75	Al. Ch.	ARY	720
75	G.E.	1M	600
60	*Westg.	CW-762C	900
50	*Al. Ch.	ARY-220-BS	1800
50	Westg.	CW	1800
50	*Al. Ch.	ARY	1200
50	Westg.	CW-636A	1200
50	Westg.	CW-658A	900
50	G.E.	MT-336	900

SLIP RING MOTORS

Crane & Hoist Service
3 Phase, 60 Cycle, 220 or 440 Volts

HP	Make	Type	Speed
80	G.E.	MTC-5552	600
75	Westg.	CI-756A	600
50	Westg.	MW-334	600
50	G.E.	HICTENV	600
35	G.E.	MTC-5538	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-3044	900

PUNCH PRESS MOTORS

NEW—3/60/220-440 Volt
High Torque—Hi-Slip

HP	Make	Type	Speed
75	Fr.-Morse	QFZK	1065
60	Westg.	CS-752-C	1060
40	Reliance	AA-B-505	1635
30	L-Allis	OK-445	1090
25	Reliance	AA-C-504	1100
15	Imperial	F-444	1090

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3750-2300-1563 KVA
Westinghouse & General Electric
400 lb. PSIG - 750 FTT, 3 Phase, 60 Cycle, 220 Volt. All with 2 pass surface condensers, exciter and control. Prints and detail available. 3750 KVA Westg. new in 1948

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 volts (*2300 volts or higher)

HP	Make	Type	Speed
1250	*Al. Ch.	ANX	3600
1200	*Al. Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al. Ch.	ARW	3600
500	*G.E.	KT569S	900
500	G.E.	KT-424	450
450	*Al. Ch.	ARW	1800
400	G.E.	KT-424	360
300	*G.E.	K-6344Y	1200
300	G.E.	K-6353TEFC	720
250	Westg.	CS-TEFC	1800
250	G.E.	KT-559	1800
250	*L.-Allis	OEX-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
250	*Cr. Wh.	SC-68	900
200	*G.E.	FT-540Y	3600
200	*G.E.	IK-13B	1800
200	Al. Ch.	ARWWT	585
200	*Westg.	CS	600
200	G.E.	K-6352	514
150	G.E.	IE-13A	1800
150	G.E.	IE-13B	1200
150	*Al. Ch.	AN-30F	1200
150	U.S.	SC-587	1200
150	Westg.	CS-7728	1200
150	*Westg.	CS-8120STEC	1200
150	Westg.	CS-876C TEFC	900
150	*Westg.	CS	600
125	Westg.	CS-771 Sapf	1800
125	*Al. Ch.	AR	1800
125	Al. Ch.	AR-226 CS	1800
125	*Reliance	AA 6085	900
100	Westg.	CS607S TEFC	3600

D.C. MOTORS

(*230 Volt)

HP	Make	Type	Speed
250	Westg.	SK-220	450/900
200	Westg.	SK-201	650
200	Cr. Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	350/1000
50/120	G.E.	MCF	250/1000
50	Cr. Wh.	CMC	700/1100
50	G.E.	DLC-204	650
35	Westg.	SK-150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E.	CD-115	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000
20	Star	SB-10	1750

M.G. SETS

KW	Make	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12,000	600
500	Westg.	2300	275
300	Westg.	2300/440	250
400	A.C.	2300	120/240
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.G.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
100	G.E.	2300	250
100	Elec. Mach.	440	125
100	G.E.	440	125
90	G.E.	440	60

CHICAGO Electric Co.

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NEW 25 CYCLE — MOTORS AT LONG DISCOUNTS

Qu.	HP	Make	Phase	Volts	Brg.	Frame	RPM
16	¼	Wag.	1	110/220	SL	65X	1425
9	½	Wag.	1	110/220	SL	65X	1425
10	½	Whse.	3	220/440	SL	145	1425
8	¾	Whse.	3	220/440	SL	186	1425
3	¾	Whse.	3	550	BB	186	1425
3	¾	G.E.	3	220	SL	77	1425
3	1	L.A.splash	3	550	BB	224	1450
5	1	Whse.	3	220/440	SL	FX224	1450
7	2	L.A.splash	3	550	BB	FX225	1450
5	3	L.A.splash	3	550	BB	FX254	1450
1	5	L.A.splash	3	550	BB	FX284	1450
3	10	L.A. XP	3	220/440		JEX364	1450
1	15	G.E. used	3	220/440		365	1450
1	25	Rel. XP	3	220/440		405	1450

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80—1½ KVA, Line Material, Dry tpe, 120/240/480 volt primary to 120/240 volt secondary with taps, 1 phase, 60 cycle
3—250 KVA, General Electric, OISC, 2300 volt primary, 460/230/115 volt secondary, 1 phase, 60 cycle
6—500 KVA, Westinghouse, OISC, 2300 volt primary, 460/230 volt secondary, 1 phase, 60 cycle

BENSON-WILIMZIG, INC.
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Phone GArfield 1-4290

SUB STATION POWER EQUIPMENT

3 Westinghouse Electric Transformers, single phase, 2000 KVA, 69,000 to 13,200 volts, 60 cycle.
6 Westinghouse SV auto-valve lightning arresters on 66,000 volt lines and 6-200 amp. copper choke coils.
2 GE oil circuit breakers. Type F. Form K026, 70,000 volts, 150 amps.
GE oil circuit breaker Type KE FHO389-480-F73A, 69,000 volts, 600 amps.
17 GE Disconnect switches, single pole, single throw, truss blade, 150 amp., 70,000 volt.
18 GE Disconnect switches, single pole, single throw, 300 amp., 15,000 volt.
9 Disconnect switches, 2000 amp., 70,000 volt. Type B, mfd. by Industrial Railway and Eng. Co.
1 Underground Oil Tank, 1250 gal. capacity.
1 Oil Testing Jet.
1 66,000 volt Line Panel Board.

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2500 KW G.E. Non-C. 3/60/2400/4160 V. 3600 RPM 185 PSIG 30# BP will change to 375 PSIG TT 700° 85# Extr.

1500 KW West. Non-C. extr. 3/60/2400 V 3600 RPM 450 PSIG 75# extr. 12# BP

750 KW Terry-Allis cond. extr. 3/60/240 V 3600 RPM, 190 PSIG 50# extr.

Full line power equipment

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50 Church St., New York 7, N. Y.

40-50-150-250 HP Package Boilers.
300 & 500 KW Engine-Generator Sets.
1200 HP Slow Speed S'lip Rg. Motor.
500' Sections 42" Belt Conveyors.
250 HP HRT Boilers — Never Used.
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1—West. Cent. Pump, 14AF, single stage, 870 rpm, 63 feet head, 6000 gpm, West. C.S. Induction motor, 3-60-2200V, pipe fittings.

LUTZ & MAY COMPANY
819 Finance Bldg., Kansas City 5, Mo.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.
Will sell turbines separately if desired. *Price reasonable.*
Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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5318 Hetzel St. **Cincinnati 27, Ohio**
40 Years' Dependable Service

DIESEL GENERATOR SETS

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2—360 HP F&M Mod 32, 14x17, 257 RPM, with F&M generators 3/60/2400 vt, w/auxiliaries. As a Lot, $10.00 per HP.
1—600 HP F&M 5 cyl. 14x17, Mod 33, 400 RPM with generator and auxiliaries.
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1—500 HP Worthington, w/generator. Many others.

GENERAL MACHINERY & EQUIPMENT CO., INC.
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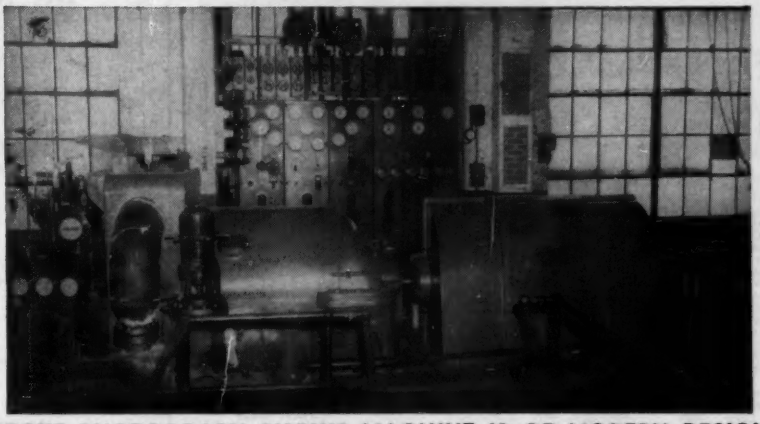
2000-KW. at 80% PF., 2500-KVA.

A MODERN WESTINGHOUSE, 400# psig., 750°FTT., 2300-V. CONDENSING TURBINE-GENERATOR AN EXCEPTIONALLY GOOD MACHINE

Units are Complete with All Operating Auxiliaries.



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Also 2—2000-KW., Westinghouse 400# psig., 750°FTT.; One 1250-KW. Genl. Electric., 400# psig., 750°FTT. All 2300-Volts. Good Condition.

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STEAM TURBINE DRIVEN

GPM	TFH	Stage	Mfg.
450	892	4	Worth. (2)
500	850	4	Worth.
200	1375	6	Ingersoll R. (2)
200	850	2	Weinman (2)
190	1320	4	De Laval
750	725	4	Worth. (2)

MOTOR DRIVEN

GPM	TFH	Stage	Mfg.
740	2250	5	Worth.
700	1550	6	Worth.
675	1100	5	LeCourtenay
500	1050	5	Worth. (3)
100	1150	5	Gould

UNDERWRITERS FIRE PUMP

GPM	TFH	Stage	Mfg.
1500	231	1 (motor driven)	Fairbanks
750	231	(gas. driven)	Allis Chal. (2)

MOTOR DRIVEN SAND PUMPS
American Manganese 10"
Allen-Shaffer-Neff 14"

NASH HYTOR COMPRESSORS
(4) size #2, 850 R.P.M., 10# pressure, 240 C.F.M.; 800 R.P.M., 100 C.F.M., when used as a Vacuum Pump.

2—2000 Gal. cap. 100# steam press. hot water storage heaters, mfg. by Quaker City Iron Works. Good shape.

This is only a partial listing of pumps carried in stock. We have hundreds of other pumps, compressors, and power equipment. Don't ask us what we have, write and tell us what you want.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa.

SPECIALS

1—5000 KVA TURBO GENERATOR, Condensing, 400 PSI.
1—200 KW MG SET, 250 Volts DC, 2300/3/60.
2—300 HP KEWANEE BOILERS, 125 PSI.
2—150 HP UNION WATER TUBE BOILERS, 160 PSI.
1—250 HP B&W BOILER, 150 PSI.
2—4' x 135' STEEL STACKS.
1—70,000 LB. HEINE BOILER, 400 PSI.
1—4133 CFM, I.R. COMPRESSOR, steam driven.
1—1000 CFM, I.R. COMPRESSOR 173 HP Sync. drive.

BRIDGE CRANES

120 ton Cleveland, 70'6" span, 3/60/440.
120 ton Niles, 68' span, 3/60/440.
60 ton Niles, 70'6" span, 230 volts DC (2).
40 ton Niles, 16'5" span, 3/60/440.
40 ton Niles, 70'8" span, 230 volts DC.
20 ton Niles, 63'10" span, 3/60/440.
15 ton Morgan, 75'8" span, 3/60/440 (3).
7½ ton Morgan, 52' span, 3/60/440.
5 ton Niles, 47' span, 230 volts DC.

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Murray Hill 7-5280
(Machinery & Equipment Merchants)

FOR SALE
1—5000 KVA Turbo Generator, 400 psi condensing 3/60/2400/4150 volts.
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1—Worthington 830 HP, LCT-6 Gas Compressor.
1—Worthington 400 HP, LCT-3 Gas Compressor.
3—Clark 800 HP, RAD-8 Diesel Compressors.
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100 KW to 1500 KW
Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators
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A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
485	Allis Ch.	1 brg.	480	600
312	Gen. Elec.	ATI	240/480	900
275	G.E. 25 cycle	ATI	480	750
225	Gen. Elec.	ATI	240/480	900
156	El. Machy		240/480	900
150	Whse.		2300/480	600
125	Whse.	1 phase	120/240	1200
94	Whse.	late	240/480	1200

50 ARTHUR WAGNER COMPANY 1906 1956 — 50TH ANNIVERSARY

50 YEARS OF RELIABLE SERVICE TO INDUSTRY

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	Allis Ch.	Sq. Cage	440	900
600	G.E.	Slipring	2200	600
600	G.E.	Synch.	2200	327
500	Ideal	Slipring	2300	450
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	450	400
400	Whse.	Sq. Cage	2200	514
400	G.E.	Synch.	440	450
350	G.E.	Sq. Cage	2200	1800
300	Whse.	Synch.	440	1200
300	Gen. Elec.	Slipring	220/440	1200
300	G.E.	Slipring	440	360
250	G.E. J	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse. X-P	Sq. Cage	2200	3600
250	G.E.	Slipring	220/440	720
250	G.E.	Sq. Cage	220/440	900
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	L.A. (2)	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	220/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	E.M.	Synch.	220/440	120
175	G.E. (2)	Synch.	220/440	72
150	El. Machy.	Synch.	220/440	36
150	Allis Ch. (2)	Slipring	220/440	1200
150	G.E.	Slipring	2200/440	720
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
150	Allis Ch.	Sq. Cage	440	450
125	Gen. Elec.	Slipring	440	600
125	G.E.	Slipring	220/440	720
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G.E.	Slipring	220/440	450
125	G.E. b.b.	Sq. Cage	2200/440	1200
100	Ideal	Sq. Cage	2200	1800
100	G.E.	Slipring	220/440	720

BUY CERTIFIED REBUILT MOTORS AND GENERATORS

Save time and money with full guarantee

D. C. MOTORS

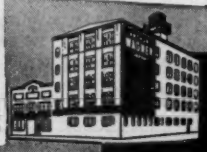
HP	Mfr.	Type	Volts	Speed
200	Reliance	1400-T	230	850
150	Whse.	SK-201	230	300/900
150	Whse.	SK-184	230	850
100	Reliance	651T	550	1000/1800
100	Reliance	651-T	230	575/1150
75	Whse.	SK-180	230	475/900
75	Cr. Wh. TEFC	53H	230	850
75	F. Morse b.b.	DH-140	230	1600
50	G.E. (3)	CD-125	115	400/1200
40	Reliance b.b.	131-T	230	1750
35	Gen. Elec.	RF-14	550	250/1000
30	Imperial b.b.	D69	230	400/1600

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
300	Gen. Elec.	2200/440 AC	250 DC
200	El. Machy.*	2200/440 AC	250 DC
200	Whse.*	220/440 AC	85 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.*	220/440 AC	250
175	Gen. Elec.	220/440 AC	250
125	Gen. Elec.*	2300/4000 AC	250 DC
105	Century b.b.	220/440 AC	250 DC
100	G.E.*	2200/440 AC	70 DC
100	Whse.	220/440 AC	125 DC
75	Cr. Wheeler	25 cycle	125 DC
75	Cr. Wh. b.b.	220/440 AC	250 DC
75	Whse.	2200/440 AC	600 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
30	Gen. Elec. (2)	220/440 AC	250 DC
25	Gen. Elec.	220/440 AC	125 DC
			250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	G.E. (2)	CY-275	260	1200
200	Reliance	1400T	250	1200
150	Whse. b.b.	SK-163L	250	1800
150	Whse.	SK-184	250	1150
105	Century b.b.	1500 amp.	70	1200
100	Allis Ch.	E	125	1200
100	Reliance	651T	600	1200
75	Cr. Wh. b.b. (2)	CCD	250	1150
75	Whse. b.b.	SK-163	125	1000
75	Whse.	SK	250	600
60	Allis Ch. (3)	E-146	250	1500



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THOUSANDS OF MACHINES IN STOCK
UP TO 1000 H.P. - AC & DC.

SEND FOR THE LATEST WAGNER MOTOR-GRAM.

Arthur Wagner Co.

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT SELECTED STOCK ITEMS

RE-NU-BUILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES — 15/2500 HP
D.C. MOTORS WITH M.G. SETS & CONTROLS

Qu.	MAKE	TYPE	VOLTS	R.P.M.
1—2200 HP	G.E.	MCF-12	600	400/500
22001KW	G.E.	Syn.	2300/4600	514
1—1350 HP	G.E.	MCF	600	600/750
1000 KW	G.E.	Syn.	2300/4600	720
1—1000 HP	G.E.	MCF-8	600	350/700
1000 KW	G.E.	Syn.	2300/4160	720
1— 200 HP	G.E.	CD-1650Z	250	500/1500
200 KW	Whse.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT	6600	257
1	1500	G.E.	MT	6900	1187
1	1100	G.E.	IM	2300	720
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1180
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	150	Whse.	CW30E17	2300	435
2	125	A.C.	ANY	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
2	650	G.E.	FT-559BY	440	3570
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	1E-15B	2300	1165
1	400	G.E.	1K	2200	500
1	200	G.E.	IK-17	440	580
8	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	4350	C.W.	3501-8L	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900
2	2000	Whse.		2300	120
1	1100	G.E.	ATI	2300/4600	900
1	735	G.E.	ATI	2200/12000	600
2	500	G.E.	TS-7567	2200	1200
1	450	Whse.		2200	450
1	400	G.E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
1	3000(3U)	G.E.	514	600	4000/6600/13200
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500 25cg	660	11000
2	2000	G.E.	514	600	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1250	Whse.	720	600	2300
1	1000	G.E.	900	250	6600
1	750	Whse.	900	250	2300/4150
1	500	Whse	900	125/250	440
1	500	Cr. Wh.	900	250	6600/13200
1	200	Whse.	1200	250	220/440
1	150	Whse.	1200	600	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva—0.7 p.f.—2300/4600 V. 3/60
Generator with 1750 Kva—.8 p.f.—2300 V. 3/60
motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	A.C.	OISC	3	33000x2400/4160
3	500	Kuhl	OISC	1	13800x6900
3	333	G.E.	HS	1	7200x2400x4160Y
3	333	G.E.	HSWR	1	2300/4000x230/460
3	333	G.E.	HD	1	13200x2530x4350Y
3	250	Penn.	OISC	1	34500x120/240
3	200	Whse.	OISC	1	13200x120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 660° F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 450/3/60.

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395 HP at 1800 RPM	550 HP at 1200 RPM
214 HP at 1200 RPM	407 HP at 900 RPM
133 HP at 900 RPM	281 HP at 720 RPM
102 HP at 720 RPM	217 HP at 600 RPM
74 HP at 600 RPM	

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Any Voltage or Frequency
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STEAM TURBINE DRIVEN

Manufactured by Warren Steam Pump Co.—26,500 GPM at 13.5 lbs. and 840 RPM. Test pressure 50 lbs.—submergence 72" water—suction lift 8" Hg. Westinghouse turbine—steam pressure 575 lbs. G.—Superheat O F—exhaust pressure 15 lb. G—HP 300—RPM 4150—Type 20-V-R-G-B—steam chest pressure 900 lbs.—serial No. Pump 23706-23708-23707—Turbines 5A1034-51-50-44.

COCHRANE DEAERATOR

Maximum pressure 20 lbs.—220,000 lbs. per hour—1800 gallons storage volume.

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313 E. BALTIMORE STREET
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SPECIAL: A 10,000-KW. @ 80% P.F., Or 12,500-KVA., Complete

GENERAL ELECTRIC TURBINE-GENERATOR SET: GOOD

FOR 400# (WITH CHANGES): WAS OPERATED AT 250#, 600° F.

12,500-KVA., General Electric Turbine-Generator is a Special Offering. Is complete with all accessories, including a 15,000 sq. ft., C. H. Wheeler, 2-pass Surface Condenser, with all auxiliaries, a complete Switchboard and an 85-KW., Direct Connected Exciter. Generator voltage is 3/60/13,800-Volts. Machine is our own property. Can make Immediate Delivery. Drawings and any further information desired will be furnished on request.

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NEW CONDITION
Attractively Priced

Used less than one year!! Riley type RO boiler 270 lb. design equipped with Peabody oil burners, Diamond Soot Blowers and Copes Feed Water Regulator. Also included is one No. 100 Thermix induced draft fan driven by a 20 HP, 600 RPM motor and a 30' x 4'3" stack and a clarage No. 2¼ forced draft fan driven by 20 HP motor. Boiler capacity 40,000 lbs./hr. Also included, but optional:—Fuel Oil Handling and storage system consisting of three large tanks, miscellaneous piping, gate valves, pumps, heaters, motors, etc. Blueprints available.

We are now dismantling three large steam power plants for a major company and offer good used equipment, such as Turbo Generator units—condensers—exciters—transformers—air compressors—pumps—motors—fans—overhead crane—Orton-Steinbrenner electric railway type crane—and other incidental equipment.

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WILL SELL INDIVIDUAL UNITS
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Capacity Each—60,000 lbs. Steam Per Hour

For Industrial Use—where large steam output is an essential requirement. If set in a series, can produce up to 480,000 lbs. of steam per hour. Individually, can be cut back to 30 to 40,000 lbs. for peak fuel-to-steam efficiency.

Manufactured by Foster Wheeler for the U.S. Navy. New, never used, never erected. Stored indoors. "D" Type 2 drum, 435 psi operating pressure, 740 deg. F. final steam temp., with superheater, economizer, fuel oil burners, soot blowers, valves and fittings. All accessories by well known manufacturers.

A tremendous buy over new manufacturers prices. Located at Utica, New York. Inspection and inquiries invited. Much larger generators also available soon.

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TRANSFORMERS 60 CYCLE

Qu	KVA	Make	Type	PH.	Voltages
2	750	G.E.	H	1	4600x120/240
1	750	G.E.	HT	3	4150Y-220/440
1	400	Pitts.	OISC	1	4150x240/480
2	333	West.	S	1	4150-240/480
2	300	G.E.	H	1	13200-110/220
3	200	G.E.	H KD	1	13800/12420/4600-240/480
3	200	G.E.	H	1	4600/12800/12420-230/460
3	50	G.E.	H	1	2400/4800-120/240
1	25	G.E.	Pyranol	1	2400/4160-120/240
3	200	G.E.	H	1	7800/15600-440/220

SYNCHRONOUS MOTORS

QU	HP	Make	Speed	Type	Volts
1	1400	G.E.	514	ATI	4150
1	1000	West.	360	MIH	2300/4150
1	500	Whse.	450	HR	440
1	300	EM	720	TEFC	2300
1	300	G.E.	600	ATI	220/440/2400
1	200	Whse.	600	ATI	240
3	200/100	Whse.	720/360	Syn.	4150
1	150	Whse.	900		220
1	150	G.E.	1800	TS	220
2	150	Allis	360		2200
1	125	G.E.	600	TS	2200
1	125	EM	900		4800
1	100	G.E.	900	TS	2200

SLIP RING MOTORS

QU	HP	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	440
1	150	Whse.	900	CW	2300
1	250	Whse.	600	CW	4
1	200	Whse.	600	CW	44
3	150	A.C.	1800	AY RW	230
1	100	G.E.	1800	IM	22
1	75	G.E.	600	IM	44
1	200	Whse.	514	CW	44

SQUIRREL CAGE 60 CYCLE

Qu.	HP	Make	Type	Speed	Volts
1	300	West.	C.S. Exp Proof	1800	220/440
2	250	G.E.	K.P. TEFC	1800	2300
1	150	G.E.	KT-562	690	440
1	100	West.	CS	1200	440

MOTOR GENERATOR SETS

QU	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 syn
1	1000	Whse.	720	600	2300/4150 syn
1	1000	Whse.	720	275	2300/4150 syn
1	300	G.E.	1200	250	2300/4150 SR
1	150	C.W.	600	125	220/440
1	100	Cr. Wh.	1200	250	Elect Mach. 550V Syn.
1	97	G.E.	1200	60	4150 Syn
1	75	G.E.	1800	250	220/440 SC
1	60	Whse.	1200	60	2200V
3	60	EM	1200	125	220
1	30	Whse.SK	1750	250	2300/4150 Syn
1	20	EM	1800	125	220 V
2	30	G.E.	1800	125	220/440 V

DC, 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
3	30	C.W.	700	CM
1	35	G.E.	860	RC
1	25	Whse.	835	SK
1	30	G.E	1650/1800	CDMS

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A.C. & D.C. DIESEL GENERATOR SETS

A.C. SETS

(3) 200 KW G.M. model 8-268A—8 cyl.—air starting—6½ x 7—heat exchanger cooled—driving Westinghouse generator—200 KW 440/3/60—1200 RPM—with direct connected exciter and complete with panel board for generator, engine starting air compressor and starting air tanks. Reconditioned by U.S. Navy. Units in excellent condition. Price on request.

(2) 25 KW—Fairbanks-Morse engine model 36A4¼—4½ x 6—40 HP at 1200 RPM—electric starting—radiator cooled—typical serial #832034. GENERATOR: G.E. 25 KW—440/3/60—1200 RPM—60% P.F.—41.6 K.V.A.—with 120 volt DC excitation—direct connected. These units are complete with panel board and distribution. Price for both, with dead front electric panel and distribution—$4375.00. Will sell singly at $2350.00 ea., with generator panel. Units recently removed from Navy ship and in good running condition.

20 KW—25 K.V.A. Buda generator set—Model 317—Buda 3 cyl.—radiator cooled—electric starting. GENERATOR 20 KW—220 volts—3 phase—60 cycle—with direct connected exciter. Good used condition. $1650.00.

(1) 125 K.V.A.—100 KW—480/3/60—1200 RPM—radiator and fan belt assembly. All set up on pre-fab sub-base. Engine model 36A5½AE—160 HP—1200 RPM—#822541—engine mfg. by Fairbanks-Morse. Electric starting. GENERATOR: F.M. 100 KW—480/3/60—1200 RPM—Frame J.F. 20D—drip-proof construction—120 volt DC excitation. RECENTLY REMOVED FROM NAVY SHIP—good condition—$4750.00.

(40) NEW AND TEST RUN ONLY—BUILT 1953 20 KW—120/208—3 phase 60 cycle 1800 RPM 4-wire ball-bearing E.M. generators with voltage regulator. Excitation 0.75 KW—62.5 volts—12 amps. ENGINE: Sheppard Model 6D—4½ x 5—3 cyl.—radiator cooled—212.8 cu. inch displacement—self-contained fuel tank—steel I-Beam base—12 volt heavy duty starter. Full generator rating 5000 to 8000 ft. Above 8000 ft., loss of 3% per 1000 ft. BARGAIN PRICE $2095.00 EACH!

D.C. SETS

20 KW GM model 2-71—2 cyl.—heat exchanger cooled—120 volt DC—167 amps—stab. shunt Delco generator model 1-3609.

30 KW—120 volt DC—Sheppard model 12—6 cyl.—4 x 6—50 HP at 1200 RPM—continuous full load rating—radiator cooled—built to ABS & AIEE #45—class A insulation—electric starting. GENERATOR: 30 KW—120 volts DC—250 amps—shunt wound—40° rise.

10 KW Superior diesel driven generator set—TEST RUN ONLY—120 volts—83.3 amps—shunt wound Delco generator model 1-3678. ENGINE: Superior G.A.B. 2—4½ x 5¾—16 HP at 1200 RPM—heat exchanger cooled. EQUAL TO NEW.

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1—40 H.P.—150 Lb. #4 Oil
1—80 H.P.—125 Lb #6 Oil
4—90 H.P.—125 Lb. #4 Oil
4—90 H.P.—125 Lb. #6 Oil
2—120 H.P.—100 Lb. #6 Oil
1—150 H.P.—125 Lb. #6 Oil
2—200 H.P.—50 Lb. #6 Oil
1—125 H.P. Cleaver-Brooks—100 Lb. #6 Oil
1—20 H.P. Powermaster 153 Lb. #2 Oil

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300 KW
DIESEL GENERATOR SET FOR SALE

Self-Contained, with General Motors engine, Fairbanks-Morse alternator, 480 volts, 3 phase, 60 cycles.

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ANSONIA, CONN.

BAILEY BOILER CONTROL PANEL

For gas and oil, has fluid meter, boiler meter, recorder controller, feed water pres. steam pressure, induced draft, etc. Little use.

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1—300 KW West. 3 Wire 125/230 Volt, 1200 RPM Generator. Any Motor—Advise Requirement.
1—150 KW G.E. Type MPC—250 Volt, 1200 RPM 3/60/2300 with 200 HP Syn. Motor Drive A.C. and D.C. Panels.
1—100 KW G.E. RC-17, 125 Volt, 3/60/220/1200 RPM.
1—75 KW Burke, 250 Volt, 900 RPM, 113 HP Burke Syn. M.D. 2 or 3 phase, 220 Volt.

DIESEL GENERATOR SETS

3—625 KVA I.R. Diesel 720 RPM 3/60/2300.
1—375 KVA G.M. 8-268 Diesel 1200 RPM 3/60/480.
1—250 KVA G.M. Twin G-71 Diesel 3/60/220.
3—125 KVA Cooper Bessemer 1200 RPM 3/60/440.
1—56 KVA Climax Gas 1200 RPM 3/60/220.
1—50 KVA G.M. 4-71 Diesel 1200 RPM 3/60/220.
1—45 KVA Continental Gas 1800 RPM 3/60/440.
4—25 KVA Continental Gas 1800 RPM 3/60/220.
1—12.5 KVA Wincharger Gas 1/60/110/220.

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2—500 HP B&W 200 Lb. Stoker.
1—300 HP Preferred 100 Lb. No. 6 oil.
1—250 HP Titusville 15 Lb. No. 6 oil.
1—200 HP Titusville 150 Lb. No. 5 oil—NEW.
1—100 HP Steamaster 100 Lb. No. 5 oil.
1—100 HP Clayton 160 Lb. No. 2 oil—NEW.
1—50 HP Clayton 160 Lb. No. 2 oil.
1—40 HP York Shipley 15 Lb. No. 2 oil—NEW.
3—20 HP Eastern 150 Lb. No. 2 oil—New.

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	800	West.	Sq Cg	2300	1800
1	600	West.	Sq Cg	2300	3600
1	400	G.E.	Syn	2300	450
1	250	G.E.	S.R.	220	600
1	200	Cont.	Sq Cg	2300	1800
1	200	G.E.	SI Rg	220	600
1	125	West.	Syn	220	600
1	100	G.E.	Sq Cg	440	1200

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Titusville Iron Works Boilers
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2—4000 KVA Allis Chalmers 3/60/2300/3600 RPM—Condensing.
1—1250 KVA DeLaval Non-Cond. 3/60/2300—240 PSI—50 Lb. B.P.
1—938 KVA G.E.-Terry Aut. Extr. 3/60/480—150 PSI—20 Lb. B.P. Surf. Cond.—1934.
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI—35 Lb. B.P.—New 1936.

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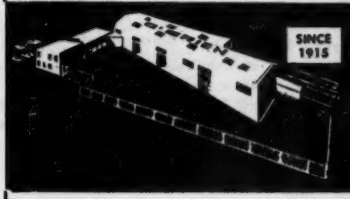
1—1600 CFM I.R. Pre-2 Syn. Mtr. Dr. 3/60/2300—100 PSI.
2—1300 CFM I.R. Pre-2 Syn. Mtr. Dr. 3/60/2300—100 PSI.
1—900 CFM C.P. 17x10x12—M.D. 3/60/440.
1—660 CFM Sullivan 11¼x7x7 100 PSI 3/60/440.
1—387 CFM Worth. 2 Stage 125 PSI 3/60/220.
1—371 CFM Schramm 7⅛x5x4 100 PSI 3/60/220.
1—271 CFM I.R. 10x10—100 PSI.
1—139 CFM C.P. 2 Stage 125 PSI 3/60/220.
1—75 CFM C.P. Tankmounted 125 PSI 3/60/220—NEW.

TRANSFORMERS

Qu	KVA	Make	Pri. V.	Sec. V	Phase
3	5000	G.E.	13,800	2400	1
3	1000	G.E. Unit Sub	12,000	2300	1
3	500	G.E. Unit Sub	23,000	2400	1
3	333	G.E.	13,200	240/480	1
3	250	Niagara	2400	240/480	1
3	167	G.E.	2400	240/480	1
3	150	West.	2400	240/480	1
3	100	West.	2400	240/480	1



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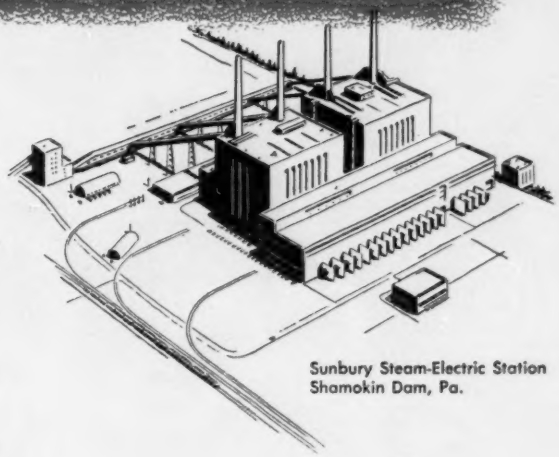

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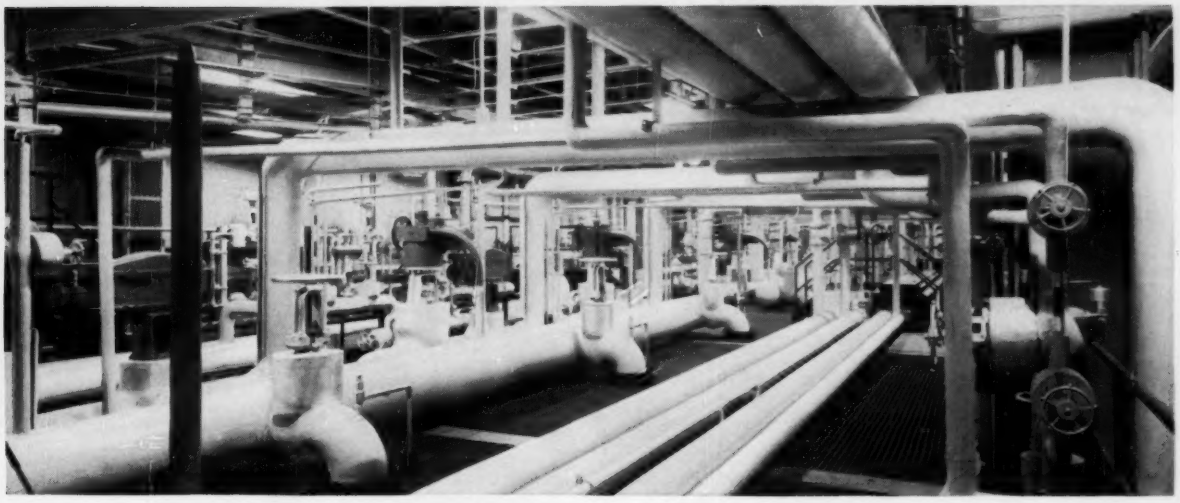

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